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BULLETIN
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TORREY BOTANICAL CLUB

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THE TORREY BOTANICAL CLUB

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MEMBERS OF THE CLUB will please remit their annual dues for 1899, now payable to Mr. Maturin L. Delafield, Jr., Treasurer, 56 Liberty St., New York City.

VOL. 26 No. 1

BULLETIN
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JANUARY 1899

Four siphoneous Algae of the Pacific Coast

BY DE ALTON SAUNDERS

(PLATE 350.)

CODIUM MUCRONATUM CALIFORNICUM J. Ag. Till Algern. System. VIII., 44.

Pl. 350, fig. 1, *a, b and c.*

The plant forms rather dense tufts of indefinite extent which are very firmly attached to the rocks by numerous, creeping, rhizoidal filaments. The plant body is erect, dichotomously divided, 1.5–3 dm. high, .5–1 cm. in diameter, of a spongy consistency, composed of a central mass of irregularly branching filaments from which arises a compact mass of unbranched peripheral filaments; the young peripheral filaments are cylindrical, ending in an acute mucron; as the filaments mature they become clavate and the mucron shorter and more obtuse. Figs. 1, *b* and *c*.

The sporangia arise from near the base of the peripheral filaments, are sessile or subsessile, cylindrical or oval, 150–300 μ long and 60–120 μ broad.

This plant has been repeatedly collected on the Pacific coast and almost uniformly referred to *Codium tomentosum* * (Huds.) Stack. The peripheral filaments of the latter species are obtuse or rounded at the end, not at all mucronate and the cell wall is only slightly thickened.† (Fig. 1 *d.*) Moreover the sporangia of

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* Harvey, Ner. Bor., **2** : 28, Pacific coast localities only. Harvey, Not. Coll. Alg. made on N. W. coast, 161. Anderson, List, etc.

† Fig. 1, *d*, was drawn from No. 168 of Phyc. Bor. Am. specimen from the coast of Jamaica.

[Issued January 16.]

the true *Codium tomentosum* are elliptical, pointed at both ends, slightly thickened at the apex and shorter—200–290 μ long and broader, 80–140 μ broad—than in *Codium mucronatum Californicum.* Compare Fig. 1, *b*, *c* and *d*.

Recently Miss J. E. Tilden has issued this same species, collected at Vancouver Island, British Columbia.* A fragment of Miss Tilden's specimens were softened and figures 1–6 and *C* were drawn from a microscopical mount of it.

The plant is common all along the Pacific Coast from Sitka as far south at least, as the southern California coast.

CODIUM ADHAERANS (Cabr.) Ag. Spec. Alg. 457. 1820.

Aghardia adhaerans Cabr. in Phys. Sallsk. Arsbr.

Pl. 350, fig. 3, a, b and c.

The plant body of this anomalous species is an irregular, blackish-green, cushion-like, spongy mass from 1 cm. to 2 dm. or more in extent. It consists of a felt-like strongly adherent mass of creeping mycelial, branching filaments 2–8 mm. thick. From the upper part of the creeping filaments arises a mass of unbranched cylindrical or clavate, erect filaments which are 1 mm. or more long, and about 100 μ wide, very obtuse or truncate and slightly thickened at the distal end.

The sporangia are cylindrical, very obtuse, sessile or subsessile, 300–400 μ long and 50 μ wide, borne laterally near the distal end of the erect filaments.

This species is rare or local on the California coast. Collected at Point Pinos (the southern point of Monterey Bay), and at Point Lobos (ten miles south of the last locality); it seems to prefer the under side of overhanging rocks.

VALONIA OVALIS (Lyngb.) Ag. Sp. Alg. **1**: 431. 1820.

Gastridum ovale Lyngb. Hydr. Dan. 72. 18. 1819.

Pl. 350, f. 2.

The plant consists of a single-celled obovate, thin-walled, inflated, sessile sack 2–8 mm. high and about as broad.

This delicate little plant was collected for three successive summers from a single large, flat-topped rock, incrusted by a *Melobesia*, which at the lowest tide stood in a foot of water and was exposed to the direct washing of the waves, Point Lobos (Central California coast). It has previously been reported for the North Atlantic Ocean, Faroe Islands, Northern coast of Norway, and the Santa Cruz Islands.

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*Tilden, American Algae, Century III., No. 281.

DERBESIA VAUCHERIAEFORMIS (Harv.) J. Ag. Till. Alg. System VIII., 34.

Chlorodesmis? vaucheriformis Harv. Ner. Bor. An. III., 30. *t.* *40. fig. D.*

Pl. 350, f. 4.

The filaments are tufted, light green, 1 cm. or so high, 30–40 μ broad; branches erect, few, 20–30 μ broad, obtuse at the apex, often with a cross-partition or a cuboidal cell near their union with the main filament. The sporangia are elliptical, obovate or pyriform, 140–200 μ long and 50–80 μ wide; zoöspores large, 12–20 in a sporangia.

This species was collected but once, at Point Lobos, the last of June, 1896, in the same locality as the last species. The plant is slightly smaller than the measurement given by Dr. Farlow* for the same species from the Atlantic Coast but agrees in all other particulars. Not only do the sporangial stalks possess a cuboidal cell but either a cuboidal cell or a cross-partition is usually found near the base of the vegetative branches.

In the size of the tufts and the diameter of the vegetative filaments this species is very similar to *Derbesia marina* (Lyngb.) Solier,† which perhaps should be considered as only a form of *D. vaucheriaeformis* as has been shown by Dr. Farlow! The sporangia of *D. marina* according to Solier's figures, are shorter stalked and the sporangia are oblong and elliptical and but little narrowed below. Unfortunately no measurements of the sporangia are given. If the two species should prove to be distinct there is no reason in writing the latter as Dr. Toni‡ has done, *Derbesia marina* (Lyngb.) Kjellman, Ishv. Alg. Fl., for Kjellman in that very monograph writes it *Derbesia marina* (Lyngb.) Solier and cites the article of Solier referred to above.§

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*Farlow, Mar. Alg. New Eng. 60.

† Solier, Ann. Sci. Nat., III. 7: 158, *pl. 9, figs. 1–17.*

‡ De Toni, Syl. Alg. 1: 426.

§ Kiellman, Ishv. Alg. Fl., 387.

Explanation of Plate 350

FIG. 1, *a*, *b* and *c*. *Codium mucronatum Californicum* J. Ag. *a*, a single plant, reduced one-half. *b*, a young peripheral filament bearing sporangium, × 50. *c*, mature peripheral filament, × 50. *d*, a peripheral filament and sporangium of *Codium tomentosum* (Huds.) Stack.

FIG. 2. *Valonia ovalis* (Lyngb.) Ag., × 2. Attached to a *Melobesia*.

FIG. 3, *a*, *b* and *c*. Peripheral filaments bearing sporangia of *Codium adhaerans* (Cabe) Ag., × 50.

FIG. 4. *Derbesia vaucheriaeforme* (Harv.) J. Ag. *b*, a filament, × 20. *c* and *d*, early stage in the development of the sporangium, × 350. *d*, a mature sporangium showing zoöspore, × 350.

The figures were drawn by Miss Emma Williams.

New Plants from Wyoming.—V *

BY AVEN NELSON

Scirpus paludosus

Perennial from corm-like tubers, which bear short, horizontal rootstocks that produce terminally other propagative tubers : culms moderately stout, erect, 4–8 dm. high, triangular, the two faces plane, the other narrower and somewhat grooved : leaves pale green, often equalling or even exceeding the culms, 5–8 mm. wide, glabrous, longitudinally nerve-grooved (11–25 nervures) : involucral leaves 2 (possibly rarely 3), both much exceeding the inflorescence, the shorter from 5–10 cm. long, the other twice or thrice as long : spikelets 3 to several in a dense, terminal head, ovate or oval, 10–20 mm. long, 6–10 mm. in diameter : scales narrowly ovate, membranous, puberulent, light brown, two-toothed at apex, the midrib prolonged into an awn about one-fourth as long as the scale ; bristles usually 2, twice the length of the akene ; style about 8 mm. long, two-cleft for less than half its length ; akene lenticular, broadly obovate, nearly 3 mm. long, tipped with a conical tooth, brown, the surface shiny, finely pitted under a lens.

This species is probably most closely related to *S. campestris* Britton, from which it is clearly separated by its remarkable tubers (subspherical, 10–25 mm. in diameter), to say nothing of the minor characters given in the description. It is a plant that thrives in the most pronounced saline soils. The first specimens were secured on Salt Creek, near Newcastle, July 30, 1896, but it seems to occur in all the strongly alkaline marshes in the southern part of the state as well. The best specimens were secured at Granger, Sweetwater County, from the salt-encrusted bed of a dry pond where it was absolutely the only vegetation. Some of the soil (?), where it was growing, was taken for analysis and found to contain more than 60% of soluble salts.

Type specimen in Herbarium University of Wyoming, no. 3874, Granger, July 30, 1897. Collected also on the Laramie Plains in the margins of the Soda Lakes that occur at intervals. The tubers are never absent ; the growth is often luxuriant and where it is accessible cattle eat it with avidity.

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* Professor Nelson has generously deposited cotypes of these plants in the herbarium of Columbia University.—ED.

Sagittaria hebetiloba

Monoecious with the lower verticils fertile, scapes 1–3, 2–5 dm. high, simple: leaves several, apparently all similar; petioles about equaling the scapes, rather stout, blade large, 8–14 cm. long (including the lobes), curved on the margins, subacute, lobes short, rounded-obtuse, about one third the length of the rest of the blade: bracts linear-lanceolate, 15–20 mm. long, subscarious, greenish-veined, spreading or reflexed: flowers large, about 2 cm. across; inner perianth leaves white, obovate or orbicular, the outer oval, greenish-veined, scarious-margined: pedicels short, ascending, 10–25 mm. long, fertile and sterile about equal: stamens 15–25, filament scarcely longer than the anther, but slightly dilated at base: fruiting head globular, 10–14 mm. in diameter: akene about 2 mm. long, obovate, tapering gradually toward the base, winged on both margins and around the summit, more narrowly so on the side of the beak; beak oblique or erect, very short, merely a blunt tooth equaling the rounded summit of the body of the akene.

Possibly local, observed but once, growing half emergent in a warm spring bog. Type specimen no. 2763, Platte Cañon, Laramie County, August 27, 1896.

Lilium montanum

Bulb 15–25 mm. in diameter, depressed globose, its thick fleshy scales from ovate to broadly obovate: stems 3–4 dm. high, rather stout: leaves glabrous, dark green, but slightly lighter on the lower face, minutely roughened on the edges, alternate except the uppermost, the upper whorl of 5–7, a second whorl of fewer leaves occasionally present, from narrowly to broadly lanceolate, tapering but slightly toward the sessile base, 4–6 cm. long, smaller downward, the lower reduced to scarious scales: one-flowered on a comparatively stout erect peduncle which is scarcely longer than the subtending leaves; perianth segments ascending, tips not reflexed, elliptic-oblong, tapering gradually towards both ends, the apex terminating in a short obtuse tooth, the claw short and broad (margined) less than a third the length of the blade, from brownish-red on the inner face to orange-red on the other, the orange-colored base of the inner face dotted with numerous purplish-black spots: stamens and stigma purplish: capsules oblong-cylindric, 3–4 cm. long.

For some time I have suspected that this was new, but in the absence of abundant material I have tentatively held it either under the name of *L. umbellatum* or *L. Philadelphicum*, to both of which it is related in some of its characters. It differs, however, from both in its stouter habit, broader leaves, single flower, broader bulb scales and floral characters. It has the leaf arrangement of *L. umbellatum* but even broader leaflets than *L. Philadelphicum.* Both of the preceding are found in dry soil while this occurs only in rich, shaded bog lands, mostly at subalpine (7000–9000 ft.) stations but sometimes in cold wet ground at lower altitudes. Secured at several points in this state and probably found in similar situations throughout the northern Rockies. Type specimen no. 4376 by Mr. Elias Nelson from Saw Mill creek in the Laramie Hills, July 1, 1898.

Abronia elliptica

Perennial from a thick, deep-set, semi-fleshy, branched root: stems several from the crown, ascending, the underground portion rhizome-like and scaly, leafy above, minutely viscid-pubescent, branched from the base only, the branches 1–2 dm. long: leaves fleshy, glabrous, somewhat wrinkled when dry, mostly elliptic, more rarely oval or ovate, obtuse at both ends or somewhat truncate or subcordate at base, 15–30 mm. long; petioles from 1–3 times as long as the blade: bracts of the involucre obovate, subacute, 8–15 mm. long, mostly 5 in number, greenish-white: flowers greenish-white, numerous in the cluster, the individual flowers inconspicuous, 15–20 mm. long, the tube slightly dilated upwards, limb small, lobes suborbicular, sinus narrow: fruit obscurely pubescent, turbinate, summit truncate or subcordate, the sides bearing five vertical wings with rounded obtuse summits, the central cavity of the fruit extending through them, about 7 mm. high; akene oblong, 3–4 mm. long, loosely sheathed by winged pericarp.

A very distinct species, readily recognized among those hitherto described. In habit, but not in size, it suggests *A. fragrans* Nutt., while in fruit character it belongs with the *A. latifolia* group. It is of frequent occurrence in south-central Wyoming on the white desert-like, Cretaceous clay slopes of the Red Desert and other similar regions. Type specimen in Herbarium University of Wyoming, no. 3024, Green River, May 30, 1897. Excellently fruited specimens from Medicine Bow, July 9, 1898, by Mr. Elias Nelson.

Arenaria Uintahensis

Perennial, caespitose, the numerous, spreading branches of caudex sub-ligneous: leaves chiefly basal on the crowns, numerous, in fascicles, glabrous, narrowly linear, acerose, 1–2.5 cm.

long: stems 1, or sometimes 2, from each crown, glabrous below, minutely glandular pubescent above, slender, erect, 10–15 cm. long, few-leaved, nodes not conspicuously swollen, the lower internodes equaled by the leaves, the upper several times longer than the leaves: cyme loose, primary pedicels 10–25 mm., secondary 5–10 mm. long: sepals narrowly ovate, acute, nerveless, scarious, obtusely keeled by the broad, green midrib: petals oblong, obtuse, about 5 mm. long, 2 mm. broad: capsule hardly equaling the sepals, about as long as the divaricate styles, ovate, splitting into ovate, obtuse valves: seeds suborbicular.

Probably nearest to *A. capillaris* Poir from which its stouter habits, its acuminate sepals and its subequal sepals and petals most obviously separate it.

It occurred along the loose shale of the higher bluffs overlooking Bear River, and did not seem to be at all abundant. Type specimen in Herb. University of Wyoming, no. 4640, Cokeville, Uintah Co., June 11, 1898.

Aconitum ramosum

Stem 3–5 dm. high, simple below, more or less branched above, the branches ascending, nearly or quite glabrous below, increasingly finely glandular-pubescent upwards: leaves suborbicular in outline, 5–8 cm. in diameter, 3-, or more rarely, 4-parted, the divisions deeply 2- or 3-cleft, these incised, the segments oblong-lanceolate, acute: flowers medium size, sparsely short pubescent; hood 12–16 mm. long, obovate (exclusive of the beak) tapering but slightly toward the obtusish base, beak short, porrect, sub-acute; lateral sepals as broad as long, unequilateral; lower sepals oblong or broadly spatulate, ¾ as long as the lateral and from ¼ to ⅓ as wide; follicles cylindric-oblong, 15–20 mm. long, reticulately veined, nearly glabrous.

When this plant was secured its strikingly *Delphinium*-like leaves and some other characters led, in the absence of any specimen of *A. delphinifolium* DC., to its being distributed under that name. During a recent visit to the Missouri Botanical Garden, an examination of the specimens in the Herbarium shows that *A. delphinifolium*, that plant of the far Northwest, is a very different thing from this. This is strict and has fewer, larger leaves with fewer and longer segments, a very different pubescence as well as some differences in flower and fruit characters.

Secured but once, no. 2549, in open grassy ground in a park on Limestone Range, Black Hills, Weston Co., near the South Dakota line, July 30, 1897. Here it occurred in great profusion though in a day's drive through that region it was met with but once.

Astragalus brevicaulis

Caespitose, the spreading leaves forming a small mat 8–12 cm. in diameter, appressed silvery-pubescent throughout, perennial from a small, vertical woody tap-root which bears at its summit a caudex of a few short, thickish branches: leaves crowded on the crowns, the persistent stipules and petioles clothing the branches of the caudex; leaflets usually 5, closely approximated at the end of the slender, 2–4 cm. long petioles, from obovate to oblong, 5–10 mm. long: peduncles exceeding the leaves, 1–several-flowered, prostrate-ascending; flowers purple, large for the plant; calyx purplish, campanulo-cylindric, tube about 5 mm. long, generally split nearly to the base by the developing pod, teeth about half as long: banner 15 mm. long, blade orbicular, 10 mm. in diameter; wings nearly as long as the banner, blade oblong, 2-lobed at apex, the basal lobe large, paralleling the long slender claw; keel shorter, rounded-obtuse: pod minutely pubescent, sessile, 2-celled or nearly so, falcate, deeply sulcate dorsally, cross section obcordate, 15 mm. or more in length, 4–5 mm. broad: ovules 20–30; seeds fewer.

This species seems to be most closely allied to *A. calycosus* Torr., but its purple flowers, larger falcate pod will serve for its immediate separation. It is a rare plant of the desert region of southern Wyoming, occurring sparingly on gravelly ridges. Type specimen no. 4601, from near Ft. Bridger, June 9, 1898.

Astragalus junciformis

Perennial from a deep-set root, the caudex slender-branched, cinereous-pubescent: stems usually several, more or less paniculately branched throughout their length, 2–4 dm. high, often somewhat striate: stipules small, triangular; leaves either reduced to a naked, slender petiole and rachis, 4–7 cm. long, or bearing 5–7 distant, linear-oblong leaflets, 8–15 mm. long: peduncles equalling or exceeding the leaves, from very few- to many-flowered; flowers about 10 mm. long, orchroleucous: standard short and broad, almost reniform, the claw short; keel broad with an elongated but blunt apex: calyx pubescent with intermingled dark hairs, campanulate, teeth minute: pod strictly one-celled, neither suture much thickened, compressed, linear-oblong, straight, probably about 3 cm. long (fully mature legume not a hand), pubescence similar to that of the stem; pedicels short, divaricate or reflexed (probably all ultimately reflexed): ovules reniform, rather large, nearly filling the pod.

This in habit suggests *A. junceus* Gray, but possibly it is more closely allied to *A. Coltoni* Jones. Its junciform stems and leaves are very characteristic. So far I have found this species in but one locality, viz., near Point of Rocks, Sweetwater Co., where it is an occasional plant on sandy, stony slopes. First secured in 1897, no. 3081 and again, 1898, no. 4839. It comes into blossom early in June.

Astragalus exilifolius

An acaulescent perennial from large, deep-set roots; caudex multicipital, closely caespitose: leaves densely crowded on the crown, simple, narrowly linear, the petiole-like base almost filiform, 2–4 cm. long, pungently acute, sparsely short hirsute, the dead leaves persisting for a time on the branches of the caudex: stipules scarious, ovate, imbricated, the largest 5 mm. long: peduncles about equaling the leaves, 1–2-flowered; pedicels short, bracts small, scarious: calyx campanulate, glabrous, or nearly so, its lobes subulate, shorter than the 3–4 mm. long tube: corolla showy, 15–20 mm. long, white, the keel tipped with purple: pod sessile, 1-celled, oblong, slightly curved with an acuminate apex, purple mottled, 12–15 mm. long, both sutures prominent, the ventral sharply keeled; seeds few (1–4).

This adds one more member to the section in which *A. spatulatus* Sheld. and *A simplicifolius* Wats. are the conspicuous members. The characters of this separate it more sharply from both of those than they are separated from each other.

It is of the desert region of south-central Wyoming, occurring as rounded tufts on the barren clay ridges of the Cretaceous formation. Type specimen, no. 4493, by Mr. Elias Nelson, Freezeout Hills, Carbon County, July 10, 1898. Collected also in the Rattlesnake Hills, no. 4996.

Astragalus aculeatus

Perennial, the stout woody caudex bearing numerous, slender, appressed-caespitose branches, hardly rising above the surface of the soil, the mats from one to several decimeters in diameter: leaves numerous, crowded on the short stems the bases of which are covered with the persistent dead ones: leaflets 5–7, linear-oblong, plane, involute or somewhat channelled, pungently long mucronate, about 8 mm. long, green but under a lens sparsely hirsute: stipules scarious hirsute on the margins: peduncles about equaling the leaves, from 2–several-flowered: flowers purple, 5–6 mm. long: calyx campanulate, the slender lobes equalling the tube, hirsute, usually some black hairs intermingled: banner broadly obovate, wings elliptic: pod 1-celled, sessile, narrowly ovate, acuminate, hardly exceeding the calyx-lobes.

It seems to be nearest to *A. Kentrophyta* Gray but is distinguished at once by its matted habit, its green leaves, its purple, peduncled flowers as well as by its habitat. This is strictly alpine, forming mats below the snow drifts at the upper limits of vegetation. Type specimen, no. 2445, from the higher summits of the Big Horn Mts., near Dome Lake, July 18, 1896.

I am again indebted to Dr. Rydberg for a comparison of the co-types, sent to Columbia University with specimens of nearly related species. Most of them I also personally studied critically at the Herbarium of the Missouri Botanical Garden. Of these, as well as of those published in previous papers, representative specimens will be placed, whenever possible, in other herbaria including Mo. Bot. Garden, Gray, National, Cornell, etc. The types are all preserved in Herb. University of Wyoming.

Mycological Notes.—IV

By Byron D. Halsted

Mould of the Paeonia.—During the last week of May a most remarkable development of *Botrytis vulgaris* Fr. was met with upon garden paeonias. At that time the plants were in an apparently vigorous condition ; they were pushing their flower stalks and the buds beginning to show pink color. While the outer leaves of the clumps were in a healthy condition all the inner ones hung brown and lifeless upon the stems and were overrun with a surprising growth of *Botrytis.*

This fungus is not uncommon upon the old leaves late in the season and the flowers may show it occasionally ; in fact no. 2459 of Ellis and Everhart's N. A. Fungi is this species collected upon paeonia petals by Dr. Kellerman.

In the present instance the fungus was playing no saprophytic rôle, but flourished as a parasite upon the rank spring herbage of the host and, at the time examined, was spreading upon the outermost leaves of the clusters. It seems to be a clear case of an unusual outbreak of a comparatively harmless paeonia fungus destroying all the foliage that was not directly in sight.

The conditions favoring this are the many rainy days that preceded the time of the inspection, there having been eighteen out of the twenty-eight upon which showers had fallen, and the excessive cloudy weather—the month up to that time having a record of twenty dark days.

The writer has had no better illustration of the influence of rainfall and consequent absence of sunshine upon fungous growth, for in this case only the outermost leaves exposed to the sun and air were healthful, while all within the umbrella-like cover that these made were dead or dying and literally covered with a dense growth of conidiophores and the multitudes of spores. The young foliage that otherwise might have been normal was destroyed by the *Botrytis* that had been highly favored by continued moisture, lack of sunshine and the confinement of the spore-laden air in the interior of the clumps.

Rust of Phlox subulata.—*Phlox subulata* L. grows quite abundantly upon the red shale cliffs in the vicinity of New Brunswick. As its name suggests it is a prostrate plant sending up short flower stalks in very early spring. By the first of June it is like a mat of moss upon the exposed places where it grows.

Attention was attracted to this plant upon a recent botanical excursion by the more upright habit of some of the specimens. A closer examination revealed the fact that they were attacked by a rust. In passing it may be stated that low creeping plants are quite apt to have the stems more upright when infested by a rust.

The rust in question is quite different microscopically from *Puccinia plumbaria* Pk., that is found upon *Phlox divaricata* L., *P. longifolia* Nutt. and *P. Douglasii* Hook., but agrees closely with *Puccinia Gileae* Ell. & Hark., as found upon *Gilia divaricata* Torr., *G. squarrosa* H. & A. and *G. intertexta* Steud.

Dr. Kelsey has distributed it upon *Phlox Richardsonii* Hook. from Helena, Montana, and is given upon *P. caespitosa* Nutt. var. *condensata* Gr. in Farlow's Host Index.

So far as is learned from the locality of the hosts and the specimens of the species in the herbarium, namely: From California, collected by Dr. Harkness, the author of the species, upon *Gilia divaricata* Torr., two specimens from Moses Craig, Corvallis, Oregon, one upon *Gilia squarrosa* H. & A., and the other upon *G. intertexta* Stend., and the specimens from Dr. Kelsey, collected at Helena, Montana, upon *Phlox Richardsonii* Hook., it would seem that the species of rust is particularly a far western one, and the present find extends its range to the Atlantic coast.

The so-to-speak eastern rust of the *Phlox*, *Puccinia plumbaria* described by Peck in volume six of the Botanical Gazette and mentioned for Illinois by Dr. Burreell, also reaches across the continent, for Dr. Harkness collected it in California upon *Phlox Douglasii* Hark. Thus the two species are widespread in the United States and probably not as yet found elsewhere.

Sun-exposed Leaves and Blight.—That the leaf blight (*Cylindrosporium padi* Karst.), is often more abundant upon one half of the cherry leaf than the other, has been a matter of observation for years and the cause of the peculiarity was not determined in the writer's case at least, until recently, when after an inspection of fifty trees the fact of the relation of sun exposure to the development of the blight became known.

The first theory employed was the position of the leaf upon the twig, but there were so many exceptions to the rule that the latter was not established. The cherry leaf has a way of bending the two halves of the blade upward so that the underside of the leaf is the only one in sight and may be unequally exposed accordingly. Such leaves upon any tree hang in all possible positions in relation to the sun, but taking a tree as a whole, there is a shady and a sunny side. In like manner there are some of the leaves so posed that one of the upturned halves is southward. When such leaves are situated upon the south side of the tree the conditions are fulfilled for the production of an instance when the fungus of the leaf is largely confined to the sunny half.

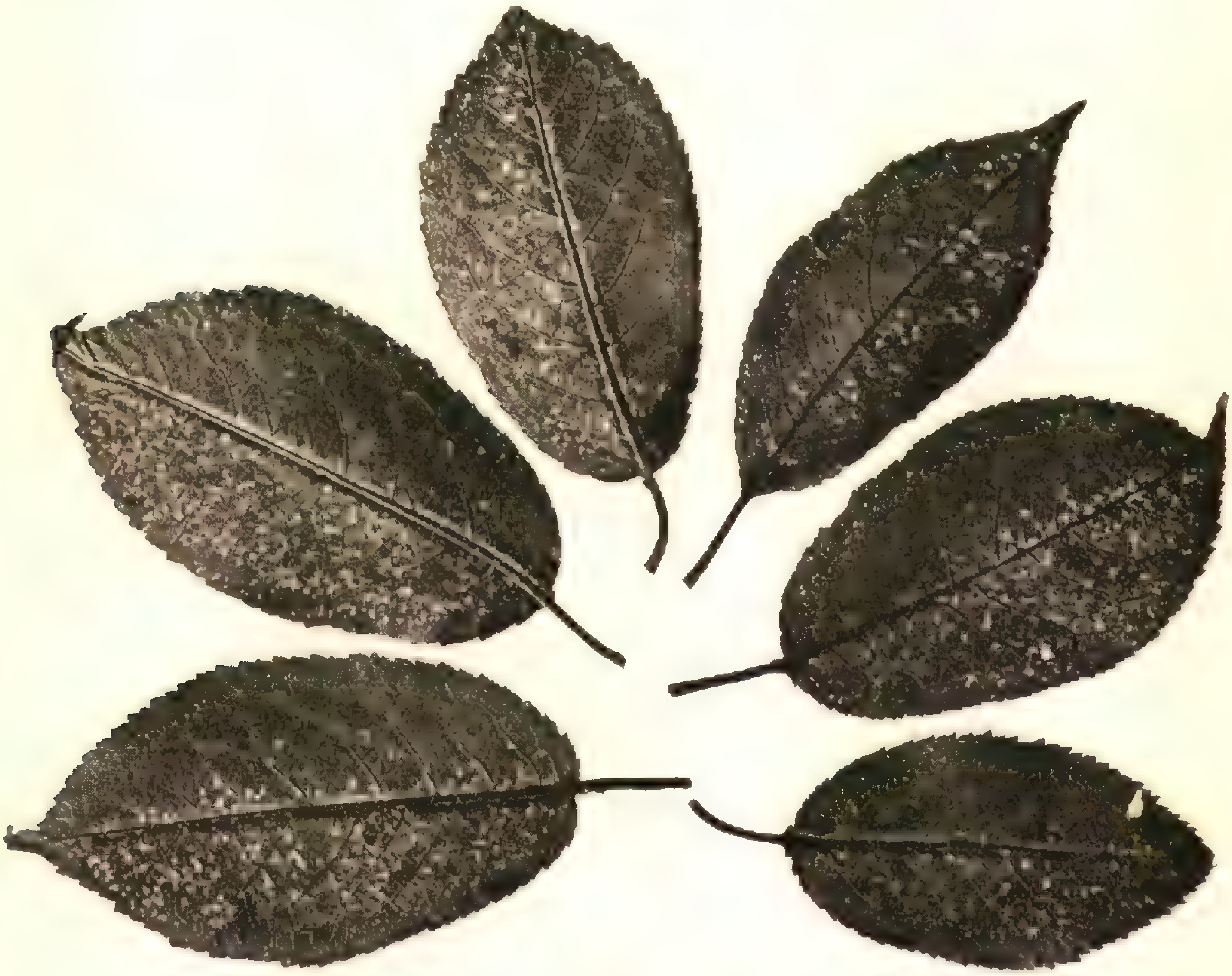

FIG. 1.

The observations were made in part upon small trees and the observer's eye could take the position of sun, that is, the rays of sunlight at mid-day were parallel to the line of vision when the person was so placed as to see the greatest abundance of the fungus upon the leaf in question or in fact upon the whole tree.

How the excess of blight is brought about by this exposure is not demonstrated for it may be that the position, unnatural in part at least, brings about a scalding or burning of the tissue of the underside of the leaf, which is reasonably assumed to be less hardy than that of the upper side; and this in turn, might prepare the way for the better entrance of the germs or their more vigorous growth after once within the leaf, already partially devitalized. It is possible also that the sunny side may furnish the more favorable conditions of warmth, etc., for the development of the blight. Fig. 1 shows some instances of cherry leaves that have a large majority of the spore spots of the blight fungus upon one-half of their underside. The three upon the right hand were from the southwest side of the tree and the other three from the southeast side.

Influence of Fungi upon Fruitfulness of Host.—While inspecting the asparagus fields in New Jersey for the prevalence of the rust, one fact came out that is seemingly contrary to a general law of vegetable physiology, namely, the influence the rust seems to have upon fruitfulness. In the years before the rust made its appearance the autumn "brush" of the pistillate plants were heavily loaded with berries, and late in the season the ripened fruit gave a bright red coloration to the field. During the present season the berries are very few indeed, and nearly all the plants appear as if they were staminate.

It is safe to assume that the rust since its first appearance in 1896 has weakened the plants, making the crop of spring smaller than usual and materially reducing the size of the autumn growth.

In other words the plant's life was in jeopardy and as a consequence an increased tendency would be expected toward fruitfulness. When the life of an individual is in danger there is an attempt, as a rule, to reproduce by seed.

This exception to the general rule does not seem to arise from the rust actually blighting the flowers, but upon the other hand, the blossoms did not form and the great majority of the plants showed no signs of reproduction.

The Trenton Goldbach poison Case.—On Saturday, October

13th, Herman Gebhardt, a workman in Trenton, N. J., went nutting to Crosswick Creek near Bordentown, and while there gathered some fine specimens of a toadstool. When near his home he went into a butcher shop kept by Harry Goldbach to have his walnuts weighed. He exhibited his mushrooms, as he thought them to be, and Goldbach was attracted by them and bought a quantity. Gebhardt took the remaining ones to his boarding place and asked his landlady to have them prepared for his supper, but his wish was not granted, it being late and inconvenient, and he carried them to Walters' saloon near by and were placed behind the bar until morning where Mrs. Walters seeing them, removed the lot of six or seven toadstools and burned them. From a conversation with Mrs. Walters and her description of the size and color of stipe, cap, gills, etc., it was quite clear that the species was *Amanita phalloides* (L.). This view was confirmed by Mr. V. K. Chestnut of the U. S. Department of Agriculture, who with Gebhardt visited the place where the toadstools were gathered and saw other specimens, which Gebhardt pronounced to be of the same kind that he had sold.

The specimens obtained by Goldbach were cooked upon Sunday morning and eaten by the whole family of nine except Max Goldbach. In a talk with the County Physician Rogers and the other physicians in charge of the cases it was learned that the first symptoms of poisoning were observed on Sunday evening when violent vomiting set in with all the eight who partook of the toadstools, and it was very prolonged. On Monday night all became worse the leading characteristic being as stated great weakness. Early upon Tuesday morning Mrs. Goldbach and her eight-year-old son died at nearly the same time, and at four o'clock in the afternoon the father died after great agony.

At the time of my visit four other victims were prostrated and in a very weak condition, while a two-year-old child had entirely recovered. Later advices indicate that all except the three previously mentioned will recover.

Fungus prolongs the apparent Vitality of Host.—During the autumn months a smut (*Ustilago Rabenhorstiana* Kuehn) is common upon the crab grass (*Panicum sanguinale* L.) and doubtless has a material effect in reducing the amount of seed produced by the weed. There is a very striking difference between the normal and the infested plants that renders it an easy matter to distinguish them. The smutted specimens, invariably the whole plant, are much more leafy and the inflorescence rarely comes to view, but remains as a plump mass of black spores inclosed by the uppermost leaves.

One of the points of interest connected with the smutted *Panicum* is the fact that it remains green long after the healthy plants have turned brown or lost their leaves. In going over a field covered with the crab grass in late October the smutted plants are quickly detected by the profusion of leaves of a deep green color. Such plants often send out new roots at the joints, as if making a desperate attempt at fruitfulness in spite of the smut that changes each flower cluster into dusty spores as soon as it is formed.

From the nature of the smuts generally and the observed facts in this case, it is probable that the infection takes place while the plants are quite young and the fungus afterwards infests all portions.

Early in the life of the plant the habit of growth is changed, and the fungus reaches the full fruitful condition before it is visible. It is only in the advanced stage of the disease that the mass of spores comes to view by the separation of the leaf bases that previously hid it from sight. In the normal plant the stem elongates and carried up the forked inflorescence, but here the stem remains short with its tip inclosed within enlarged leaves that are of darker green than the healthy plants. This same dark green is characteristic of the turnip plant that is having its roots destroyed by the club-root fungus—a very conspicuous shade of green to those who recognize it.

One Fungus develops in the Host Immunity from another.—In a recent collecting tour it developed by inspection that the rust *Puccinia mamillata* Schrt., while common upon the ordinary plants of the climbing smart weed (*Polygonum dumetorum* L.) it was nearly absent from all those infested with *Ustilago anomala* J. Kunge. It would seem that the smut had taken possession of the plant and the latter did not longer furnish the proper feeding ground for the rust. The same thing was found true in case of the smutted specimens of *Panicum sanguinale* L., the leaves of which are rarely affected with *Piricularia grisea* (Cke.), while the normal plants have the foliage quite generally spotted with it.

In a bed of fruiting radishes the writer had also noticed that certain plants will have the inflorescence malformed by the *Peronospora parasitica* (Pers.), while others close at hand were victims of the *Cystopus candidus* (Pers.); but it is rare that a flower or seed vessel bears both of these common fungi. To a limited extent it would seem that the radish infested with the white mould is immune from the mildew, which is generally considered as its general associate and because of the supposition that it feeds upon the *Cystopus* it has received *parasitica* as the specific portion of its name.

If the observations were extensive enough the statement possibly might be made that a wheat, rye or out plant afflicted as it is, if at all, with smut from a seedling on, would be at least partially immune from the rust. The smut gains entrance to the seedling and possibly renders the host unsuited to the entertainment of other fungous guests.

Effect of leaf Fungi upon autumn Coloration of Foliage.—Very striking illustration of the effect of leaf fungi upon the autumnal coloring of foliage was met with this year in the case of a tree of the hard or sugar maple (*Acer saccharum* Marsh). The leaves were mottled green and pale lemon yellow, particularly those upon the lower and inner branches, while the upper foliage of the tree and that exposed more fully to the sun was nearly uniformly yellow. It would seem from an inspection of the tree that the mottling was associated with shade and perhaps the coolness and longer periods of moisture that attend the protection of the foliage from the direct sunshine.

The spots upon the otherwise yellow leaves were of all sizes but averaged a half inch or so in diameter and were of a green color, irregular in outline and disposed without order, some leaves having but one green blotch while others had nearly the whole area occupied by them. Fig. 2 shows a leaf with the blotches. The color values of green and yellow are so nearly the same as to make it difficult to get a sharp photograph of the spots.

A microscopic examination of the under surface of the mottled leaves showed clearly that a fungus was invariably associated with the blotches, it being the common maple mildew (*Uncinula circi-*

nata C. & P.). It was interesting to note that, in the present stage of the fungus, a few mature perithecia were to be found at or near the geographical center of the blotch, usually along side of a vein and the hyphae extended radially to the margin.

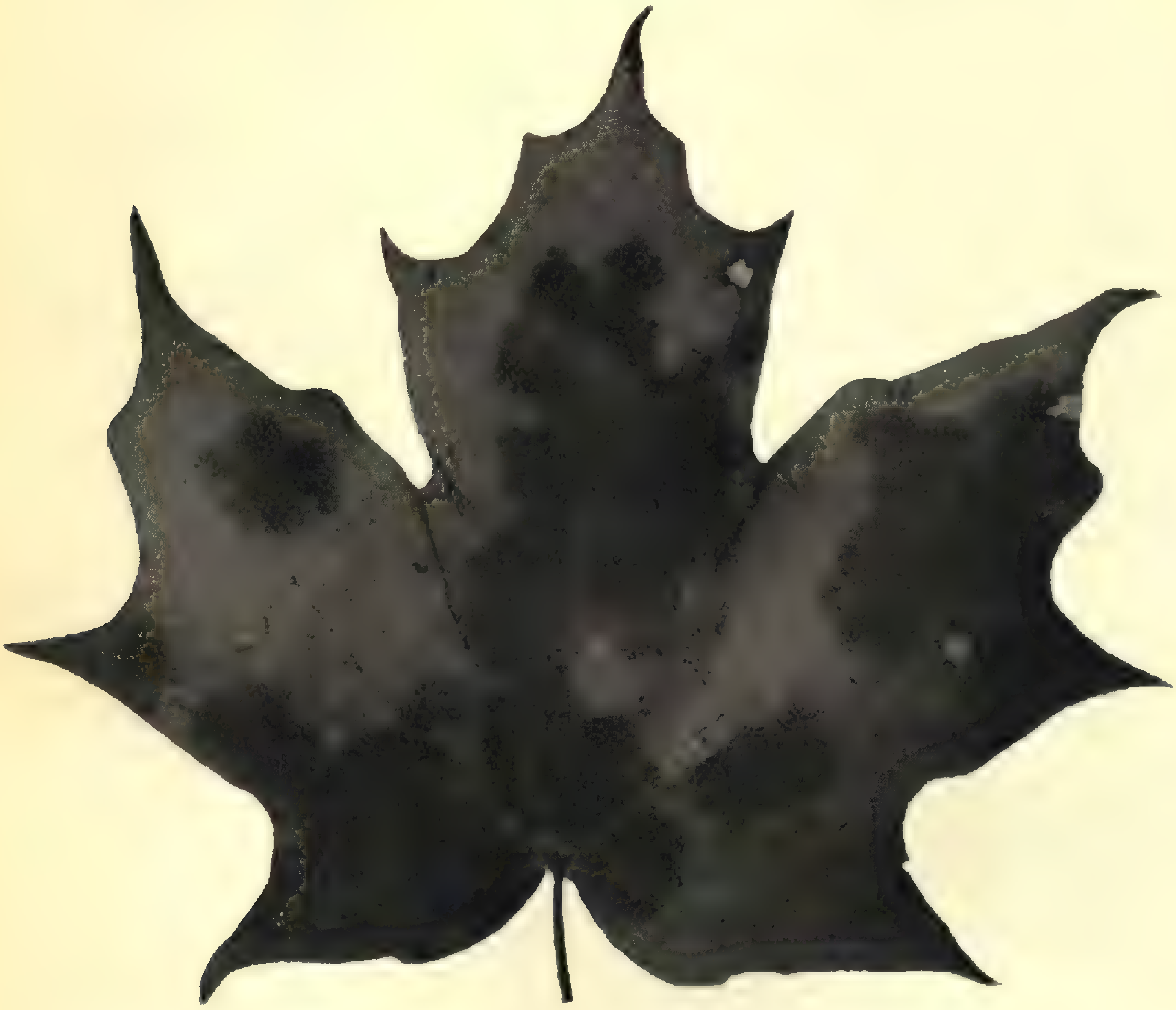

FIG. 2.

The fungus, judging from the size of the perithecia, must needs have been upon the leaf long before any discoloration began to take place and probably had spread to the full extent of the blotch before its presence could have been detected by the autumn discoloration.

Much of interest centers in the action of the fungus upon the portion of the host that is under its immediate influence. Whether it renders the affected protoplasm sluggish so that the chlorophyl is not withdrawn, or the cells more active by supplying them with the proper nourishment and the work of synthesis goes on as usual, are conjectures simply and no explanation of the peculiar phenomenon in question. To look at the leaves it would seem to be a case of symbiosis of the mutualistic sort.

Late Growth of Bean Mildew.— *Phytophthora phaseoli* Thax., upon the Lima bean is remarkable in that it thrives upon the pods after the plants are killed by the frost. Upon October 24th, the writer could have picked from one large field bushels of pods in all stages of growth that were badly infested with the mildew and in a very flourishing condition. It is true, however, that while the foliage of the beans was destroyed by the frosts the pods remained apparently untouched, and therefore the tissue upon which the fungus grows is uninjured. The facts remain, nevertheless, that this *Phytophthora* grows luxuriantly in the cool weather of late autumn.

A new Species of Lacinaria

By H. Ness

(Plate 351.)

Lacinaria cymosa

Perennial from globular or oblong tuberous root 1–2 cm. in diameter: stem slender, erect, rigid, 35–45 cm. high, corymbosely branched above, leafy puberulent throughout: leaves smoothish and minutely punctate; the radical and lower cauline 15–20 cm. long and 1–1.5 cm. wide, lanceolate and tapering at the base to a clasping petiole; the upper sessile, linear, and gradually smaller: inflorescence a simple or, on stronger specimens, a compound cyme; heads about 25 mm. high, with about 20 purplish-red or pale-purplish flowers; involucre about 2 cm. long, oblong-cylindrical; scales numerous, closely imbricated in about six series, puberulent and ciliate-margined, with rounded or almost truncate, appressed, and often slightly mucronate apices; the outer orbicular to oblong; the inner oblong to linear with dark-purplish tips: pappus purplish, plumose, shorter than corolla-tube, but about equal to the achenes; the corolla about 15 mm. long, smooth inside, with lanceolate, obtusish spreading teeth; stamens included, with the usual notched terminal appendages; style exserted, the branches flat, dilated upwards, and several times longer than the short purple-colored stigmatic lines; achenes oblong, about 8 mm. long, 10-ribbed, hispid on the ribs.

This plant was found during October, 1896, one mile south from the Agricultural and Mechanical College of Texas, growing in a limited number over about two acres of ground, where the stiff clayey soil is so poor that only a few species of grass dispute the ground with it. I have not been able to find it in any other place. In the following autumn, when the spot was again visited, for the purpose of obtaining more specimens, I found that the plants had apparently increased in number, and were spreading beyond the area where they were first discovered.

This species differs from the other species of *Lacinaria* in having a rather loose, corymboid cyme, reminding one of *Vernonia.* In the heads it somewhat resembles *L. cylindracea* Michx., having about the same number of flowers and a somewhat similar involucre; the scales are larger, however, more appressed and less distinctly mucronate. It also differs from that species in having the corolla smooth inside, and the leaves more distinctly punctate.

Explanation of Plate 351.

FIG. 1. Floret.
FIG. 2. Stamens.
FIG. 3. Radical leaf.

TEXAS AGRICULTURAL COLLEGE.

Proceedings of the Club.

Tuesday Evening, October 11, 1896.

There were thirty-one members present. President Brown in the chair.

One nomination for corresponding membership was reported by Dr. H. H. Rusby, of Dr. Manuel Gomez de la Mazo, University of Havana, Havana, Cuba.

The evening was devoted to informal reports of summer observations and experiences. The Secretary spoke of collections in the White Mountains, and on the Massachusetts Coast and near Lake Erie. He reported the discovery of a locality for *Aster phlogifolius* in fine typical development at Pelham Manor, adjoining New York City.

Dr. Britton spoke of the progress made at the Botanical Garden, especially in the advancement of the museum building, and reported the prosperous condition of the herbaceous grounds, now with over 2,700 species, a mass of bloom during the season. One day in July the visitors to the grounds numbered 4,000. Interesting questions of specific identity are being confirmed by cultivation at the garden, as in case of *Potentilla pumila*.

Dr. Britton also announced the forthcoming scientific expedition to Porto Rico, Mr. A. A. Heller going as botanist under the auspices of the New York Botanical Garden through the liberality of Mr. Cornelius Vanderbilt.

Dr. Underwood reported collections in the forests of Thüringen and examination of fern types at Berlin and Kew. He referred to the excellent preservation of the plants of Willdenow at Berlin, and to the strength of the Berlin herbarium, enriched among the ferns by the annotations of Prantl, the collections of Mettenius, Maximilian Kuhn, and the Hawaiian herbarium of Hildebrand. Dr. Underwood described the botanical garden laid out by Professor Engler in Berlin, exhibiting modern ideas of geographic distribution. He also spent some weeks at Kew.

Dr. Rusby reported a summer spent largely in procuring material for the study of drugs in powdered condition. Drugs now come chiefly to the pharmacist powdered, and adulterants are less easily recognized.

The search for genuine *Apocynum cannabinum*, with broad, thick leaves, woolly beneath, has proved disappointing, *A. album*, with recurving habit, replacing it in the region about New York City. Dr. Rusby also reported the rediscovery of *Euonymus atropurpureus*, rare near New York, found near Little Falls, N. J., at an excursion of this club in June last.

Mr. A. A. Heller spoke of his experience in the Olympic Mountains, where the continuous rains interfered with collections. Ferns grew in great profusion and often five feet high, but of few species. The Salmonberry varied from yellow to deep red, and was often an inch in diameter, on bushes ten feet high. *Oxalis Oregana* made a fine display, as also several species of *Vaccinium*, *V. parvifolium* with red, and *V. ovalifolium* with blue berries. An introduced blackberry, *Rubus laciniatus*, is now well established there, blooming from July to Christmas, and known as the Evergreen Blackberry. *Spiraea Menziesii* grew up by the streams, with its rose-colored spike a foot and a half high. *Lilium Columbianum* appeared in the meadows. There were not many representatives of any family ; only about twenty composites out of 230 plants collected, of grasses about thirty-five. In August and September Mr. Heller collected in Texas and Arkansas with marked success.

Professor Lloyd reported a summer spent in study in the laboratory of Professor Goebel, at Munich, and commented upon the botanical garden there, which, although of but a few acres, is exceedingly well arranged for educational purposes.

Dr. M. A. Howe reported work on the hepaticae, and his discovery, on a hemlock stump in the New York Botanical Garden, of genuine *Cephalozia connivens* for the first time in the United States, the plant distributed by Austin under that name proving a different species.

Dr. Small spoke of work in Tennessee, and Mrs. Britton in the Adirondacks and elsewhere. Miss Ingersoll exhibited photographs of *Cypripedium spectabile*. Miss Sanial called attention to the color variation in *Monotropa uniflora* at Sterling, New York, where she found a region in which all the specimens were pink.

Mr. Clute reported work on the sand barren flora of eastern Long Island. Among his collections were *Dryopteris simulata*, only once before recorded from New York State ; *Kneiffia Alleni*, new to North America ; *Pogonia verticillata*, in quantity near Southampton ; *Kalmia latifolia*, within twenty-five feet of the sea-level ; *Potentilla pumila* and *P. Canadensis* growing together without intermediate forms.

Discussion regarding violets followed. Professor Britton exhibited some fresh flowers of *Viola cucullata*, borne on peduncles normally cleistogene, and with some of the flowers transitional in character. President Brown spoke of similar flowering in *V. sagittata*. Dr. Britton and the secretary reported their collecting cleistogenes of *V. Atlantica* this season for the first time.

Mr. Clute spoke of his study of the cleistogenes in *V. cucullata*, *V. ovata*, *V. rostrata* and *V. Canadensis*, and of their development during the heat of summer. He observed the need of cool temperature to secure free flowering in *Viola*, as also seen in the greenhouse cultivation of pansies. Mrs. Britton called attention to the continuous summer blooming of *V. tricolor* in the cooler climate of the Adirondacks and of the Alps. Mrs. Britton also reported the collection at Lake Placid of *Viola arenaria*, for the first time in New York State.

WEDNESDAY EVENING, OCTOBER 26, 1898.

The evening was one of severe and continuous rain and ten persons only were present.

In the absence of other officers Professor Underwood presided.

The resignations of Miss Amy Schüssler and of Mr. Wm. C. Witter were accepted.

Dr. Underwood was made chairman of a committee to make arrangements for courtesies to visiting botanists of the Society for Plant Morphology and Physiology at its approaching session at Columbia University, beginning December 27. He was empowered to select his associates on the committee and to report at the next meeting of the club.

The scientific program consisted of a paper by Mr. W. A. Bastedo on " The Pharmacology of Sassafras," read by title in the absence of its author ; and a paper by Dr. N. L. Britton on " A new *Helianthus* from Long Island." Dr. Britton told the story of the discovery of this new species, which appears to be an ally of *H. Maximiliani* of the West, and which was found by Dr. Britton, near Sag Harbor, on July 16, 1898.

Dr. Underwood discussed the too prevalent neglect of rootstock characters, seldom represented in herbaria, but often widely separating species otherwise too closely grouped together, as in *Struthiopteris* and *Onoclea*.

Miss Ingersoll called attention to potatoes exhibited at the instance of Dr. Rusby. These tubers were themselves penetrated to the center by tuberous rootstocks apparently of *Cyperus esculentus*.

NOVEMBER 8, 1898.

There were twelve persons present. Mr. A. A. Heller in the chair, in the absence of the regular officers.

Dr. Underwood reported as his associates upon the committee for entertainment of visiting botanists of the Society for Plant Morphology and Physiology at its first visit to New York on December 29 and 30, the following names: Dr. Britton, Dr. Rusby, Professor Burgess and Professor Lloyd.

The papers due were the following:

Mr. Marshall A. Howe, "Remarks on some undescribed Californian Hepaticae."

Mr. George V. Nash, "New and noteworthy North American Grasses."

Their authors being absent, and but a small attendance present, it being election night, they were on motion postponed to the next meeting.

Mr. A. A. Heller reported from the recent Staten Island excursion that *Baccharis* was found in very handsome fruiting state near the beach, and tall specimens of *Azalea viscosa* reaching twelve feet.

Dr. Underwood suggested that the Field Committee continue Saturday excursions later, on account of the interest attaching to winter stages of the higher plants and especially to the numerous lower plants for which the best collecting time is from October to May.

NOVEMBER 30, 1898.

Eighteen persons present. President Brown in the chair.

The following nominations for membership were made: By Dr. N. L. Britton, Dr. Joseph J. Sleeper, 104 West 83d Street; By Dr. Underwood, Mr. Tracy E. Hazen, Columbia University; Miss Mary A. Nichols, 256 West 84th Street.

The club listened to the following reports:

In behalf of the committee on entertainment, Dr. Underwood reported in favor of extending a reception to the Society of Plant Morphology on the evening of December 27.

Dr. Britton reported a communication from Mr. C. L. Pollard announcing the recent foundation of the Washington Botanical Club, and moved that as a club we tender it our greeting through our Secretary. This was adopted and the Secretary accordingly communicated this greeting to the Washington Botanical Club.

Discussion was called up by Dr. Britton relative to the program from the Field Committee. It was agreed that an opportunity for field meetings be provided on Saturdays after the first of January, for the purpose of studies of cryptogams and of winter stages of higher plants.

The scientific program followed.

The first paper was by Dr. Marshall A. Howe, "Remarks on some undescribed Californian Hepaticae," and consisted of the description of three new species, soon to be published. Beautiful plates illustrating these species were exhibited, the work of Dr. Howe, which with others will form a forthcoming volume of the Memoirs of the Torrey Club.

The second paper was by Professor Francis E. Lloyd, on "The Nucleus in certain Myxomycetes and Schizophyceae." Mr. Lloyd remarked that the work of Strasburger (1884) and later of Lister, gives evidence that the nucleus of the Myxomycetes is a definite organ possessed of a nuclear membrane, and containing chromatin. During cell-division, the chromatin is segregated into rounded masses lying in the nuclear plate; a spindle is formed. After the formation of a fine nuclear membrane about the daughter nuclei, the spindle fibers gradually disappear. The small number of these parallel fibers and absence of a cell-plate led Strasburger to compare the nucleus to the animal rather than the plant type. Precisely similar conditions are, however, found in some plant cells.

The presence of a nucleus in the Schizophyta has been a point of controversy. Bütschli asserts the nuclear character of the central body, and regards the red granules as chromatin. A. Fischer denies the accuracy of the former's conclusions, the question remaining an open one. When our knowledge is complete it is highly probable that the nucleus will be found to be of the distributed type, of a type therefore comparable to that of the simpler protozoa. In any case the nucleus of the lower plants is much more primitive than that of the Myxomycetes. We are led therefore to regard these curious, much-debated forms, the Myxomycetes, as either plants of a higher type than the Schizophyta which have degenerated, or as animals related probably to the Sporozoa. For the former view there is now little evidence.

The secretary addressed the club briefly regarding the discarded species *Aster gracilentus* T. & G., and exhibited its type to the members. This formed a sheet of the herbarium of M. A. Curtis, now at Princeton, and was exhibited through the courtesy of Professor Geo. Macloskie of that university.

Dr. Howe exhibited a number of examples of *Wolffia*, discovered floating in Van Cortlandt Lake, constituting the third recorded collection within New York State of this minutest of flowering plants.

Dr. Britton reported two interesting additions to the collections of the New York Botanical Garden:

1st. A valuable collection of photographs and apparatus illustrating the cultivation of the poppy in Asia Minor.

2d. A gift from Mr. Peter Barr, the English horticulturist, of a collection of *Narcissus* and *Paeonia* for planting in the Botanic Garden. The claim of free entry as museum material was at first refused by the New York Custom House, but after five different appeals, the final decision was that the material was proper to an outdoor museum, and free entry was granted.

EDWARD S. BURGESS,
Secretary.

Index to recent Literature relating to American Botany.

Alden, F. W. *Pycnanthemum lanceolatum* Pursh. Pharmaceutical Rev. **16**: 414–417. N. 1898.

Atkinson, G. F., & Stoneman, B. A provisional Key to the Genera of Hymenomycetes. (Mushrooms, Toadstools, etc.) 1–16. 6 O. 1898.

Baker, J. G. *Calochortus clavatus.* Curt. Bot. Mag. **54**: *pl. 7606.* Jl. 1898.

Native of California.

Barton, E. S. On the Fruit of *Chroospora fastigiata* J. Ag. Journ. Linn. Soc. **33**: 507, 508. *pl. 28.* 1 N. 1898.

Beal, W. J. Some unique Examples of Dispersion of Seeds and Fruits. Am. Nat. **32**: 859–866. N. 1898.

Beal, W. J. How Plants flee from their Enemies. Plant World, **1**: 26–28; 42–44. N., D. 1897.

Beecher, C. E. The Origin and Significance of Spines. Am. Jour. Sci. IV. **6**: 1–20, 125–136, 249–268, 329–359. *f. 1–73.* Je.–O. 1898.

Primarily zoölogical but also treating of plant spines.

Bessey, E. A. The comparative Morphology of the Pistils of the Ranunculaceae, Alismaceae and Rosaceae. Bot. Gaz. **26**: 297–313. *pl. 25.* N. 1898.

Bessey, C. E. Botanical Notes. A southern Fern far from Home. Science, II. **8**: 587, 588. 28 O. 1898.

Bessey, C. E. Botanical Notes. A tiny Pine Tree. Science, II. **8**: 588. 28 O. 1898.

Bessey, C. E. A vegetable Awl. Plant World, **1**: 132. Je. 1898. [Illust.]

Bessey, C. E. Report upon the Progress of the Botanical Survey of Nebraska. Plant World, **1**: 103–105. Ap. 1898.

Bibbins, A. A fossil Cypress Swamp in Maryland. Plant World, **1**: 164–166. Au. 1898.

Britton, E. G. A hybrid Moss. Plant World, **1**: 138. Je. 1898.

Britton, E. G. The Adder's Tongue Ferns. Plant World, **1**: 85–89. *f. 1–7.* Mh. 1898.

Britten, J. Bibliographical Notes.—XVI. Fabricius' "Enumeratio Plantarum Horti Helmstadiensis." Jour. Bot. **36**: 397–399. O. 1898.

Britten, J. Dedication of *Jacksonia* Raf. Jour. Bot. **36**: 399, 400. O. 1898.

Buchenau, F. *Luzula campestris* und verwandte Arten. Oestr. Bot. Zeitschr. **48**: 161–167; 209–220; 243–251; 284–297. *pl. 7.* My. Je. Jl. Au. 1898.

Chesnut, V. K. The stinging Nettles. Plant World, **1**: 116, 117. My. 1898.

Clute, W. N. The Flora of the Upper Susquehanna and its Tributaries. 12mo. 1–142. 1898.

Clute, W. N. The Ferns and Fern Allies of the Upper Susquehanna Valley. 12mo. 1–15. 1898.

Cockerell, T. D. A. Preliminary Note on the Growth of Plants in Gypsum. Science, II. **8**: 119–121. 29 Jl. 1898.

Combs, R. Histology of the Corn Leaf. Rep. Iowa Acad. Sci. **5**:—(6–10). *pl. 9–11. f. 11–13.* 1898.

Copeland, E. B. A new self-registering Transpiration Machine. Bot. Gaz. **26**: 343–348. N. 1898. [Illust.]

Coulter, J. M. The Origin of Gymnosperms and the Seed Habit. Science, II. **8**: 377–385. 23 S. 1898.

Crawford, J. The Twayblade in Cultivation. Plant World, **1**: 91, 92. M. 1898. [Illust.]

Davis, J. J. A graminicolous Doassansia. Bot. Gaz. **26**: 353, 354. N. 1898.

D. zizaniae sp. nov.

Davy, J. B. *Stapfia,* a new Genus of Meliceae and other noteworthy Grasses. Erythea, **6**: 109–113. *pl. 3.* 8 N. 1898.

Stapfia Colusana Davy, gen. et. sp. nov.

De Candolle, C. Piperaceae Bolivianae. Bull. Torr. Bot. Club, **25**: 566–572. 7 N. 1898.

Contains descriptions of several new species in *Piper* and *Piperonia.*

Dudley, W. R. Forest Reservations; with a report on the Sierra Reservation, California. Sierra Club Bull. **1**: 254–267. Ja. 1896.

Eastwood, A. Plants in Flower in November and December, 1897. Erythea, **6**: 114, 115. 8 N. 1898.

Eckles, C. H. The Relation of certain Bacteria to the Production of Butter. Centralb. für Bact. Paras. und Infek. **4**: 730–734; 759–763. 1898.

Engler, A. Beiträge zur Kenntniss der Araceae, VIII. Bot. Jahrb., **25**: 352–476. 19 Jl. 1898.

Evans, A. W. Studies among our common Hepaticae. Plant World, **1**: 97–102. *f. 1–15*; 133–137. *f. 1–21*; 182–186. *f. 1–15*. Ap. Je. S. 1898.

Evermann, B. W. The Teaching of Biology in the Public Schools. Plant World, **1**: 119–122. My. 1898.

Farlow, W. G. The Conception of Species as affected by recent Investigations on Fungi. Science, II. **8**: 423–435. 30 S. 1898.

Golden, K. E. Yeasts and their Properties. Purdue Univ. Monog. (Food) **5**: 1–28. *f. 1–8*. [1898.]

Greene, E. L. Parthenogenesis in common Plants. Plant World, **1**: 102, 103. Ap. 1898.

Halsted, B. D. Starch Distribution as affected by Fungi. Bull. Torr. Bot. Club, **25**: 573–579. 7 N. 1898.

Harshberger, J. W. Botanical Observations on the Mexican Flora, especially on the Flora of the Valley of Mexico. Proc. Acad. Nat. Sci. Phila. **1898**: 372–413. S. 1898.

Harvard, V. The vulgar or English names of Plants. Plant World, **1**: 161–163; 180–182. Au. S. 1898.

Hasse, H. E. Lichens of Southern California. 1–18. 1898. [2d ed.]

Heller, A. A. New and Interesting plants from western North America.—III. Bull. Torr. Bot. Club, **25**: 580–582. 7 N. 1898.

Hydrophyllum tenuipes, sp. nov.; previously described varieties in *Salix*, *Corylus*, *Ranunculus*, *Opulaster*, *Kalmia* and *Stachys*, raised to specific rank.

Hemsley, W. B. *Lucuma Hartii*. Hook. Ic. Pl. **26**: *pl. 2565*. Ap. 1898.

A species from Trinidad, W. I.

Hemsley, W. B. *Hevea spurceana*. Hook. Ic. Pl. **26**: *pl. 2570*. Ap. 1898.

Notes on a north Brazilian species with the description of a new species, *H. confusa*, from British Guiana.

Hemsley, W. B. *Hevea Benthamiana*. Hook. Ic. Pl. **26**: *pl. 2571*. Ap. 1898.

A north Brazilian species.

Hemsley, W. B. *Hevea minor*. Hook. Ic. Pl. **26**: *pl. 2572*. Ap. 1898.

A new species from north Brazil.

Hemsley, W. B. Heveae Specierum plurium analyses. Hook. Ic. Pl. **26**: *pl. 2573, 2574.* Ap. 1898.
Enumeration of eight species of *Hevea.*

Hemsley, W. B. Heveae Specierum plurium semina. Hook. Ic. Pl. **26**: *pl. 2575.* Ap. 1898.

Hemsley, W. B., and **Rose, J. N.** *Loeselia cordiflora.* Hook. Ic. Pl. **26**: *pl. 2551.* Ap. 1898.
A new species, collected by Palmer at Tepic, Jalisco, Mexico, in 1862.

Hemsley, W. B. *Loeselia involucrata.* Hook. Ic. Pl. **26**: *pl. 2552.* Ap. 1898.
A Mexican species.

Hemsley, W. B. *Passiflora fuchsiiflora.* Hook. Ic. Pl. **26**: *pl. 2553.* Ap. 1898.
A species from the Demerara river, British Guiana.

Hill, E. J. The Extent of Dodder Parasitism. Plant World, **1**: 123, 124. My. 1898.

Hill, E. J. A Peach with a double Plumule. Plant World, **1**: 190. S. 1898.

Hinche, C. L. Among Colorado's Wild Flowers. Plant World, **1**: 170–172. Au. 1898.

Hooker, J. D. *Philadelphus Mexicanus.* Curt. Bot. Mag. **54**: *pl. 7600.* Je. 1898.
Native of Mexico and Guatemala.

Hooker, J. D. *Ribes villosum.* Curt. Bot. Mag. **54**: *pl. 7611.* Au. 1898.
Native of Chili.

Hooker, J. D. *Calliandra fulgens.* Curt. Bot. Mag. **54**: *pl. 7626.* N. 1898.
Native of Mexico.

Hooker, J. D. *Amelanchier Canadensis* Medic. var. *oblongifolia.* Curt. Bot. Mag. **54**: *pl. 7619.* O. 1898.
Native of Eastern North America.

Hooker, J. D. *Cortaderia jubata.* Curt. Bot. Mag. **54**: *pl. 7607.* Au. 1898.
Native of the Andes.

Hooker, J. D. *Sedum glandulosum.* Curt. Bot. Mag. **54**: *pl. 7610.* Au. 1898.
Native of California and British Columbia.

Hopkins, C. G. The Chemistry of the Corn Kernel. Bull. Ill. Agric. Exper. Sta. Bull. **53**: 129–180. Jl. 1898.

Jepson, W. L. Dr. Henry N. Bolander, Botanical Explorer. Erythea, **6**: 100–107. *pl. 2.* 24 O. 1898.

Jepson, W. L. *Beckwithia*, a new Genus of Ranunculaceae. Erythea, **6**: 97–99. *pl. 1.* 24 O. 1898.

Beckwithia Andersonii (Gray) Jepson (*Beckwithia Austinae* Jepson *l. c.*).

Kalbfleisch, A. S. Orchids on Long Island. Plant World, **1**: 177–179. S. 1898.

Kearney, T. H., Jr. The Liana Vegetation of Southeastern Virginia. Plant World, **1**: 169, 170. Au. 1898.

Kearney, T. H., Jr. The Pine-Barren Flora in the East Tennessee Mountains. Plant World, **1**: 33–35. D. 1897.

Klausenburg, B. Pater-. Eine Beobachtung über *Puccinia malvacearum* Mont. Zeitschr. Pflanzenkr. **8**: 201, 202. 29 O. 1898.

Knowlton, F. H. The Elephant Tree. Plant World, **1**: 113–116. *pl. 5.* My. 1898.

Lawson, A. A. New Method of making Botanical Charts. Erythea, **6**: 113, 114. 8 N. 1898.

Lister, A. Mycetozoa of Antigua. Jour. Bot. **36**: 378, 379. O. 1898.

Lloyd, C. G. Mycological Notes. 1–8. N. 1898.

Macbride, T. H. A Pre-Kansan Peat Bed. Rep. Iowa Acad. Sci., **4**: 63–66. 1897.

Macmillan, C. *Cordyceps stylophora* Berk. & Br. in Minnesota. Bull. Torr. Bot. Club, **25**: 583. 7 N. 1898.

Macoun, W. T. List of Species of Maples growing at the Centra Experimental Farm, Ottawa. Ottawa Nat. **12**: 133–136. N. 1898

Miller, C. O. The aseptic Cultivation of Mycetozoa. Quar. Jour. Mic. Sci. **41**: 43–71. *pl. 6, 7.* Mh. 1898.

Müller, C. Analecta bryographica Antillarum. Hedwigia, **37**: 219–224. 20 Jl. 1898; 225–266. 25 O. 1898.

Includes numerous new species.

Münderlein, P. Ueber Equisetum-Formen. Deutsch. Bot. Monat. **16**: 57–59; 101–104; 121–124. Ap. Je. Jl. 1898.

Nash, G. V. Revision of the Genus *Triplasis.* Bull. Torr. Bot. Club, **25**: 561–565. 7 N. 1898.

Contains detailed descriptions of the three species; *Triplasis Americana*, sp. nov.

Paddock, W. An Apple Canker. Science, II. **8**: 595, 596. 28 O. 1898.

Pammel, L. H. Comparative Anatomy of the Corn Caryopsis. Rep. Iowa Acad. Sci. 5:—(1–5). *f. 5–10.* 1898.

Pammel, L. H., Burnip, J. R., & Thomas, H. Some Studies on the Seeds and Fruits of Berberidaceae. Rep. Iowa Acad. Sci. 5:—(11–25). *pl. 12–16. f. 14.* 1898.

Prunet, M. A. Recherches sur le black rot de la vigne. Rev. Gen. Bot. 10: 404–410. 15 O. 1898.

Pfitzer, E. Beiträge zur Systematik der Orchideen.—II. Bot. Jahrb. 25: 517–546. 1898.

Pierre, L. Observations sur quelques Landolphiées. Bull. Men. Soc. Linn. Paris. 1898: 33–40. My. 1898.

Pilger, R. Vergleichende Anatomie der Gattung *Plantago* mit Rücksicht auf die Existenzbedingungen. Bot. Jahrb. 25: 296–336; 337–351. 19 Jl. 1898.

Pollard, C. L. The Families of Flowering Plants. Plant World, 1: 5, 6; 19, 20; 37, 38; 56–58; 89–91. O. N. D. 1897. Ja. F. 1898.

Pollard, C. L. Further Observations on the Eastern acaulescent Violets. Bot. Gaz. 26: 325–342. N. 1898. [Illust.]
V. insignis sp. nov.

Putnam, H. L. Fertilization of the Crimson Thread-Flower (*Poinciana Gillesii*). Plant World, 1: 39–40. *f. 1–3.* D. 1897.

Riddle, L. C. The Embryology of *Alyssum.* Bot. Gaz. 26: 314–324. *pl. 26–28.* N. 1898.

Robinson, A. G. Blue Ridge Blossoms. Plant World, 1: 130, 131; 145–147. Je. Jl. 1898.

Rowlee, W. W. & Hastings, G. T. The Seeds and Seedlings of some Amentiferae. Bot. Gaz. 26: 349–353. *pl. 29.* N. 1898.

Sablon, L. du. Recherches sur les reserves Hydrocarbonées des Bulbes et des Tuberailes. Rev. Gen. Bot. 10: 385–403. *f. 71–74.* 15 O. 1898.

Salmon, E. S. A Revision of the Genus *Symblepharis* Montagne. Jour. Linn. Soc. 33: 486–501. *pl. 26.* 1 N. 1898.

Sanders, C. F. *Smilax glauca* in Winter. Plant World, 1: 105, 106. Ap. 1898.

Sanders, C. F. The evening Lychnis. Plant World, 1: 150, 151. Je. 1898.

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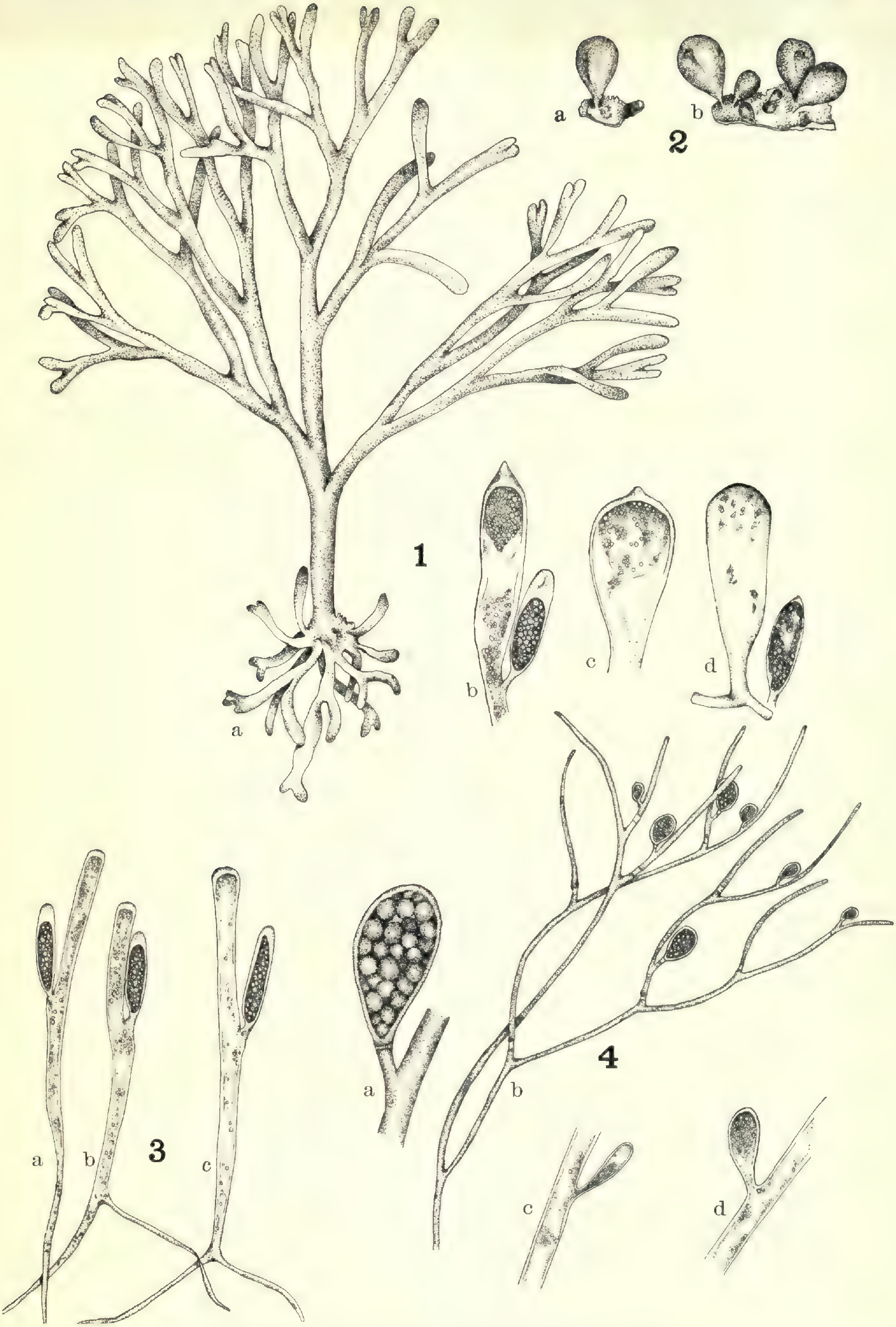
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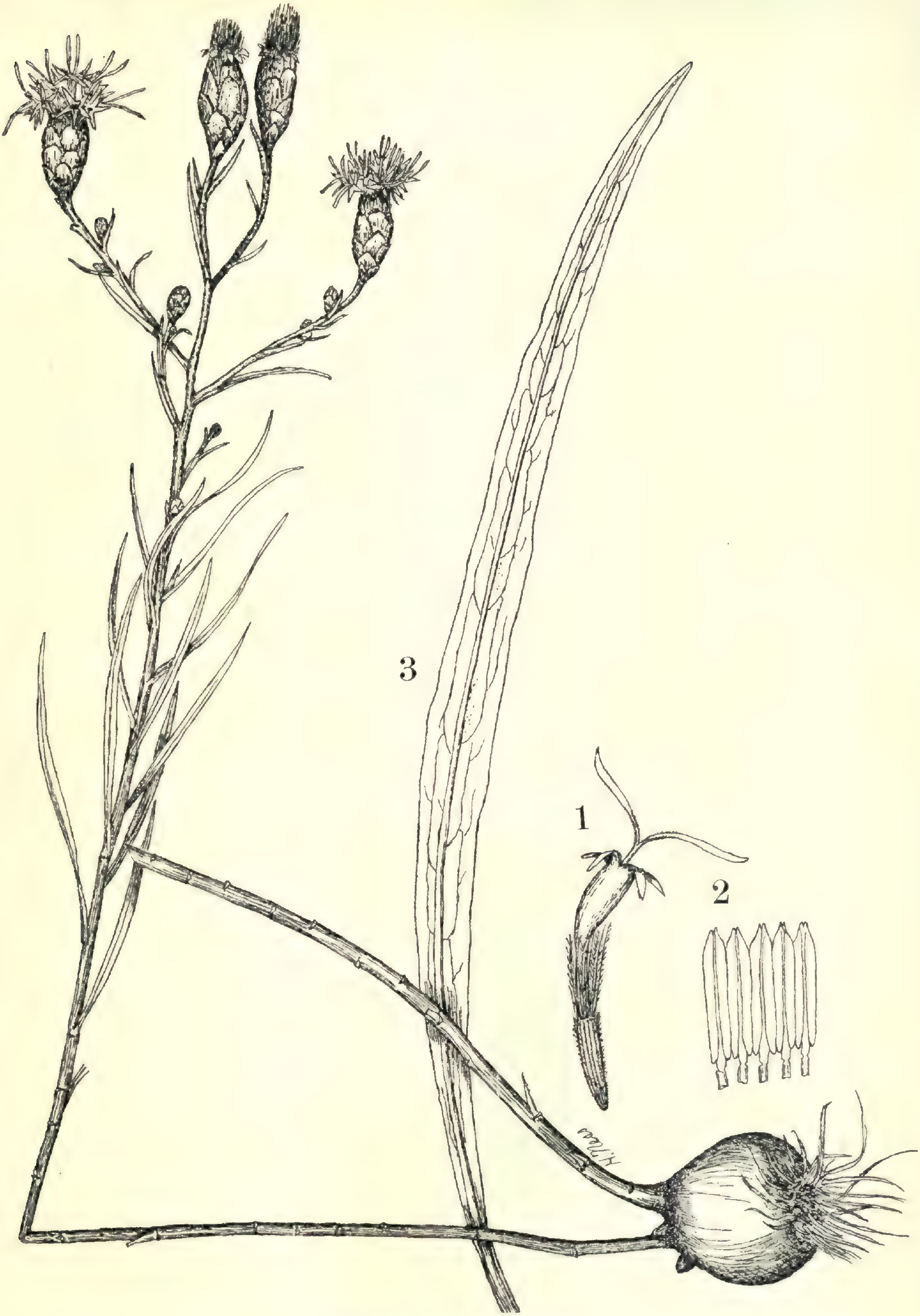

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MEMBERS OF THE CLUB will please remit their annual dues for 1899, now payable to Mr. Maturin L. Delafield, Jr., Treasurer, 56 Liberty St., New York City.

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The primary Synthesis of Proteids in Plants

BY W. M. KOZLOWSKI

Our knowledge concerning the primary products of carbon synthesis and the formation of carbohydrates in plants is in a degree exact,* but regarding the question of synthesis of proteids we are not in a position to give any plausible reasons for our suppositions. This is not strange, when we consider that the very product of this synthesis is imperfectly known and that until recently we have had no rational nor even empirical formula of proteids which we could assume with any degree of probability.

I believe that little worthy of note will be omitted if I divide into four classes the views set forth in the scientific literature upon the structure of proteids.

1. Hunt considered these as nitryls of sugar, derived from the latter and ammonia, a supposition which can hardly be reconciled with the recent results of physiological and chemical investigations.

2. Sachsse holds that they are anhydrides produced from asparagin and from fatty aldehydes.

3. According to Schützenberger they are composed of ureids, derivatives of carbamide.

4. Finally, Grimaux, in his definition of proteids as compounds which by addition of water are decomposed into carbonic

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*The author has shown in a Polish paper (Wezechswiat, 1893, Nos. 4 and 5) that the recent discoveries of E. Fischer make equally plausible three suppositions about the formation of carbohydrates from CO_2 and H_2O in plants; one of them is the well-known hypothesis of Bayer, the second was proposed by E. Fischer himself and the third by the author of the quoted paper.

[Issued February 8.]

acid, ammoniac and amidic acids, places them in the nearest vicinity with uric acid, which gives also by hydrolysis carbonic acid, ammoniac acid, glycocol.

The principal facts to be accounted for with these different hypotheses are the following:

1. The last product containing nitrogen in the metamorphosis of animals is carbamide or uric acid.

2. The compounds from which proteids are formed in plants, as will be shown later on, are most probably amides (including amidic acids and their amides, and especially asparagin) and the carbohydrates.

3. The products of decomposition of proteids under the action of pure chemical agents. These are in the most part amides which are obtained by the action of bromine,* of barium hydrate under high pressure,† of hydrochloric acid and stannous chloride,‡ by long boiling with sulphuric acid,§ or acids in greater part from the fatty series, obtained through the action of manganese dioxide and sulphuric acid || as well as chromic acid.¶ Besides carbonic acid and oxalic acid are nearly always formed.

The presence of hippuric acid in the urine of herbivorous animals, the indol and the skatol found in the products of pancreatic digestion (Salkowski), the tyrosin nearly always present in the animal body, lead to the supposition that aromatic groups are also constituents of the proteid-molecule and it even seems that some of the most characteristic color reactions of these compounds are due to them.**

We shall not pass over in silence the synthesis of colloidal bodies obtained by Grimaux and by Schützenberger, which shows a very great resemblance to proteids. Grimaux obtained his colloid by melting together asparagic anhydride with carbamide; Schützenberger by the action of epichlorhydrin upon carbamide.

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[*] Hasiwetz and Habermann, Liebig's Annalen, **159**: 304.

[†] Schützenberger, Annales de Chimie et de Physique, V. **16**: 289.

[‡] Hasiwetz and Habermann, Lieb. Ann. **169**: 150.

[§] Kreusler, Zeitschrift für Chemie, 1870: 93.

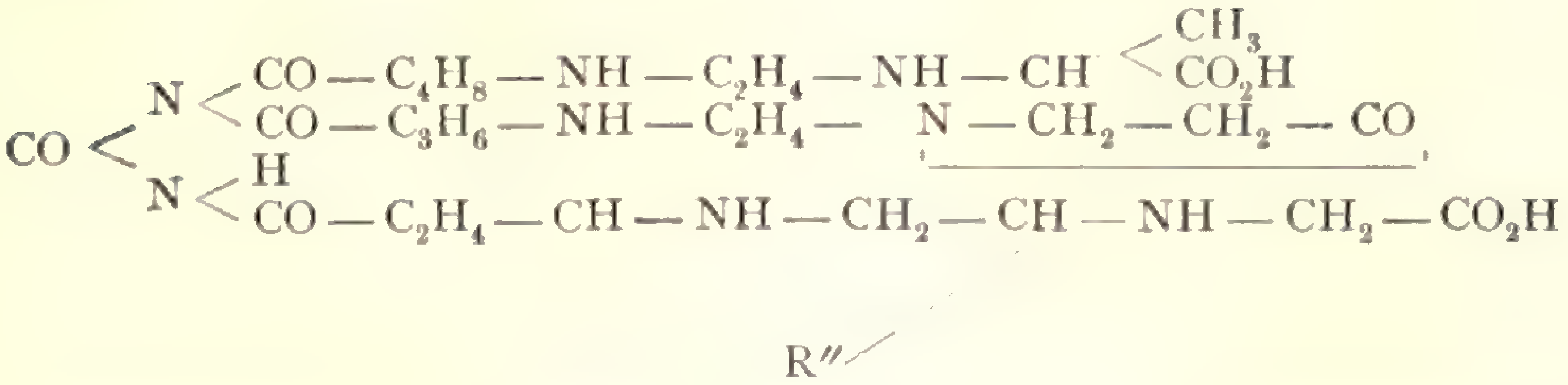
[||] Guckelberger, Liebig's Annalen, **64**: 39.

[¶] *Ibidem.*

[**] So the reaction upon krautoprotein, by Millon and Liebermann. See Würtz. Second supplement au Dictionnaire de Chemie, 1892.

Taking into consideration the qualitative and quantitative relations of compounds derived from the proteids through the action of baryta-water under high temperature (200° C.) and pressure, Schützenberger * gives formulae for albumin and gelatin, which are perhaps premature as to minute details, but no doubt give quite an adequate expression of the fundamental facts both physiological and chemical by putting at the base of the proteid molecule, two groups, the carbamide and the oxamide :

$$\mathrm{CO} < \begin{matrix} \mathrm{N} = \\ \mathrm{N} = \end{matrix} \text{ and } \mathrm{C_2O_2} < \begin{matrix} \mathrm{N} = \\ \mathrm{N} = \end{matrix}\ \dagger$$



$$\mathrm{CO} < \begin{matrix} \mathrm{N} < \begin{matrix} \mathrm{CO-C_4H_8-NH-C_2H_4-NH-CH} < \begin{matrix} \mathrm{CH_3} \\ \mathrm{CO_2H} \end{matrix} \\ \mathrm{CO-C_3H_6-NH-C_2H_4-}\ \underline{\mathrm{N-CH_2-CH_2-CO}} \end{matrix} \\ \mathrm{N} < \begin{matrix} \mathrm{H} \\ \mathrm{CO-C_2H_4-CH-NH-CH_2-CH-NH-CH_2-CO_2H} \end{matrix} \end{matrix}$$

$$\mathrm{R''}$$

The presence of these two groups will enable us to give an account of two very general facts concerning the chemistry of organization.

This is practically all that we know about the final product of synthesis of nitrogen compounds in plants. We shall take next into consideration the physiological facts elucidating that synthesis.

In the first place may be noted the changes of proteids in the germination of seeds. As colloids, they cannot be transferred from cell to cell unless they are decomposed into simpler crystalline bodies. A long series of investigations has shown that this transfer is performed in the shape of amides.

Asparagin is to be found in very many sprouting plants while it is not present in their seeds. Asparagin is not soluble in alcohol and when sections of plants are placed in that liquid it is deposited in characteristic crystals. By means of this reaction Pfeffer has shown that many seedlings contain asparagin, whether growing in light or in darkness ; in other plants it is not present. This asparagin is obviously derived from the proteids contained in

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[*] See the article of that author in the second supplement to the Dictionnaire de Chemie of Würtz (1892).

[†] We quote here the condensed formula of Schützenberger, given by Goutier in his Chimie de la cellule vivantem, 1895 :

the seed and is used to build up the protoplasm of growing parts, as shown by the experiments of Boussingault and recently it has been confirmed by Laskowski, Fleury and Detmer, that when a seedling does not receive nitrogen from outside, the quantity of that element is not changed during the germination. In other words the plant does not lose its nitrogen.

In the same conditions as sprouting seeds are the young buds of plants ; their tissues are formed from the plastic materials gathered by the plant during the foregoing summer. Thus Borodin found asparagin and sometimes tyrosin in the buds of many trees and shrubs, especially in those which are developed from twigs cut in winter and grown in dull light, indicating that light impedes directly the formation of asparagin : but Pfeffer obtained the same result when cultivating lupine in light, but in an atmosphere free from carbonic acid. Such plants were very rich in asparagin.

There is, moreover, no doubt that the accumulation of asparagin is connected with another fact, the lack of carbohydrates. In the described experiments this was due either to the cutting off of a twig (freed of leaves and thus unable to assimilate) from a tree, containing reserve carbohydrates, or to the suspension of assimilation through darkness or lack of carbonic acid. In plants, which are growing in normal conditions, the asparagin does not accumulate, for it is at once combined with the produced carbohydrates to form proteids. This inference is confirmed by the investigations of Schultze and Uhrich,* who found that the large part (34–47.7%) of nitrogen in the roots of the beet (*Beta vulgaris*) is contained in amides (specially in glutamin and asparagin), while during the growth of the leaves a large portion of these bodies is consumed to form the proteids for these organs.

Emmerling gives as the result of the first of a series of investigations, which he undertook in this line on a large scale, the following statement : "The parts of plants growing energetically contain more amide than parts which are older and already developed." †

At last experiments with seeds growing in darkness complete the preceding tests, showing that in this case amides and carbohydrates are produced from proteids. In the experiments of Uhrich, Schultz and Umlauf with seeds of lupine the result was that the plants cultivated in darkness contained 18.22% more of asparagin and 12.31% more of other amides and organic nitrogen compounds, while only 5.33% more of carbohydrates in form of glucose and cellulose than seeds ; on the other hand they contained 30.07% less of proteids. The comparatively slight increase of carbohydrates is explained by their loss from respiration, the general loss being 18.30% of dry substance.*

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* Landwirtschaftliche Versuchsstationen, **18** : (1875) and **20** : (1877).

† Landw. Versuchsstationen, **24** : 153. 1880.

All these facts prove without doubt that amides can be produced in plants from proteids, and can, together with carbohydrates, be used in their reconstruction ; they do not of course prove that we can consider amides as the predecessors of proteids when formed from inorganic substances, and the difficulty of the investigation in this line is based upon the fact that amides are always found in growing plants as the form in which proteids are transported either to the young growing parts (as buds, flowers, fruits) or to places where they are deposited as reserve food for the next year (roots, bulbs, etc.).

In order to answer this question A. Emmerling† undertook a long series of investigations, consisting of the quantitative determination of different compounds of nitrogen in different parts of plants and in various stages of their growth. These investigations led him to the belief that amides are products, preceding the formation of proteids from inorganic substances in plants.

Before this series was completed (1887) other pieces of work appeared which tend to show the same results.

Kellner was the first who tried to ascertain that proteids are formed from amides. He compared the amount of amides in plants supplied with pure water and those supplied with a solution of potassic nitrate.‡ His results were criticised by E. Schultze § chiefly on the ground that we cannot consider amides as products of the synthesis of inorganic substances, until we have proved that they are not produced from decomposition of proteids. In the meantime Hornberger and Raumer * applied the method of determination of proteids newly introduced by Stuzer. This method enables us to determine the amount of these bodies from other nitrogen compounds in plants. From the distribution of proteids and other nitrogen compounds in Indian corn, Hornberger and Raumer deduced that the amides in plants are not only derivatives of proteids, but also their predecessors produced synthetically.

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* Landwirtsch. Jahrbücher, **5** : (1876). The loss of dry substance is at the expense of fat (5.61%) and dextrine-like carbohydrates (10.02%), besides some other not fully explained substances.

† Landw. Versuchsstationen, **24** : 153 and foll. (1880).

‡ Landwirtschaftliche Jahrbücher, **8** : Suppl. 243. 1879.

§ Landw. Jahrbücher, **9** : (1880).

This result was confirmed by Hornberger,† who experimented upon *Sinapis alba* and by Emmerling who had then completed his long series of experiments.‡

On the other hand a recent publication gives a support for the second part of the supposition concerning the amides as a link between inorganic bodies and proteids. Barthold Hansteen cultivated *Lemna* in solutions of asparagin and glucose in darkness and found an obvious increase of proteids. The same result was obtained with carbamide and cane sugar as well as with salts of ammonia (ammonium chloride and sulphate) while leucin, cretin and alanin showed themselves unable to serve as proteid-producing materials.§ The last observation concerning salts of ammonium if proved to be true cannot be generalized, for experiments made under the most stringent conditions have proved that phanerogamic plants cannot use ammoniacal salts as a source of nitrogen, although that capacity is possessed by fungi.

So regarding the metamorphsis of nitrogen in plants we know that by the oxidation of the nitrates of the soil it is transformed into reduced nitrogen of amides, which by combination with carbohydrates produce proteids.

We, therefore, have to answer two questions :

1. In what organs of the plant does this transformation or its particular phases take place ?

2. What compounds are intermediate between nitric acid and

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* Landw. Jahrbücher, **11** : (1882).

† Landw. Versuchsstationen, **32** : 415. 1885.

‡ Landw. Versuchsstationen, **34** : (1887).

§ Beiträge sur Kenntniss der Eiweissbildung in phanerogamen Pflanzen. Berichte deutsch. bot. Ges. **14** : 362. 1896.

the amides on the one hand, and between the latter and proteids on the other?

The first can be answered with greater certainty owing to the investigation of the past few years. As to the second—it can be answered only hypothetically; but as every experimental science is in the same degree dependent upon facts, and upon scientific ideas, and as observation or experiment is always guided by scientific hypothesis, we ought not to throw aside suppositions which can be induced from facts and are not at variance with the general spirit of scientific thought.

As to organs in which proteids are produced a supposition was given as long ago as 1862 by Sachs,* who considered the leaves as active in this process, Hanstein was led to the same results by his experiments in girdling shoots, and Pfeffer showed that the development of blossoms and buds is dependent upon the presence of leaves and the supply of the substance which circulates in the sieve tubes.

The same conclusion must be drawn from the above quoted investigations concerning the distribution of nitrogen compounds in plants. The general result is that the organic nitrogen compounds are accumulated in leaves until the latter reach their full development, then they decrease in order to be transferred into fruits and finally disappear from the stem and the leaves while they are still increasing in the fruits even if the plant is not supplied with nitrogen from outside.

But quite decisive are the investigations of A. F. W. Schimper,† who showed by means of the reaction with diphenylamin that the nitrates pass as such through the fibro-vascular bundle of leaves and disappear in the chlorophylic cells of the mesophyl while large amounts of calcium oxalate is produced, the calcium being combined with the nitric acid as calcium nitrate entering the plant through the roots. This disappearance occurs only in light, while in darkness or in leaves free from chlorophyl the nitrates are accumulated in large amount. The experiments of Schimper and many others make it probable that in the same way sulphites and phosphites are decomposed in the leaves while the sulphur and phosphorus are used for building up the proteid molecules.

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* Botanische Zeitung, and the articles scattered through the 45 vols. of Flora (1862 *seq.*) where the cribrose vessels are indicated as the place of formation of proteids.

† Bot. Zeitung, 1888, N. N. 5–10.

We cannot however agree with the conclusion of the author that the chlorophyl grain is the organ of this synthesis, and that the last is produced only under the influence of light. The synthesis of proteids from sugar and nitrates or salts of ammonia in fungi deprived of chlorophyl contradicts such a supposition. This objection cannot be overthrown by the single remark, that the assimilation of nitrogen is in some regard different from this process in higher plants, for we have no reason to admit the necessity of light and chlorophyl to the production of proteids, since we know that such a synthesis can be produced without their influence. Of course the principal difference between fungi and chlorophyl-bearing plants does not consist in the fact that they produce proteids in different ways, but that one of the compounds necessary to that production (the carbohydrates) is taken from the outside.*

More probable is the supposition, that to the reduction of nitrates into amides or to the consequent transformation of amides into proteids some compounds or groups of atoms are necessary which are produced during the assimilation of carbon and constitute perhaps some stage in the synthesis of carbohydrates. In fungi such bodies could be produced by a retrogressive metamorphosis from carbohydrates, and the energy developed by this reaction may be used for the process of synthesis of proteids. Such a supposition is supported by the fact observed by the same author viz.: the presence of some reducing substance in the chlorophyl-bearing cells which hindered in many cases the color reaction with the diphenylamin, while neither the glucose nor the starch produce such effect.†

In this connection may be mentioned the hypothesis of Löw advanced long before the publication of the work of Schimper,‡ and based upon facts concerning the feeding of fungi. By studying experiments (especially those of Pasteur and Nägeli) to determine whether compounds with or without nitrogen can feed fungi Löw found that only the compounds containing the group CH.OH are able to produce proteids.

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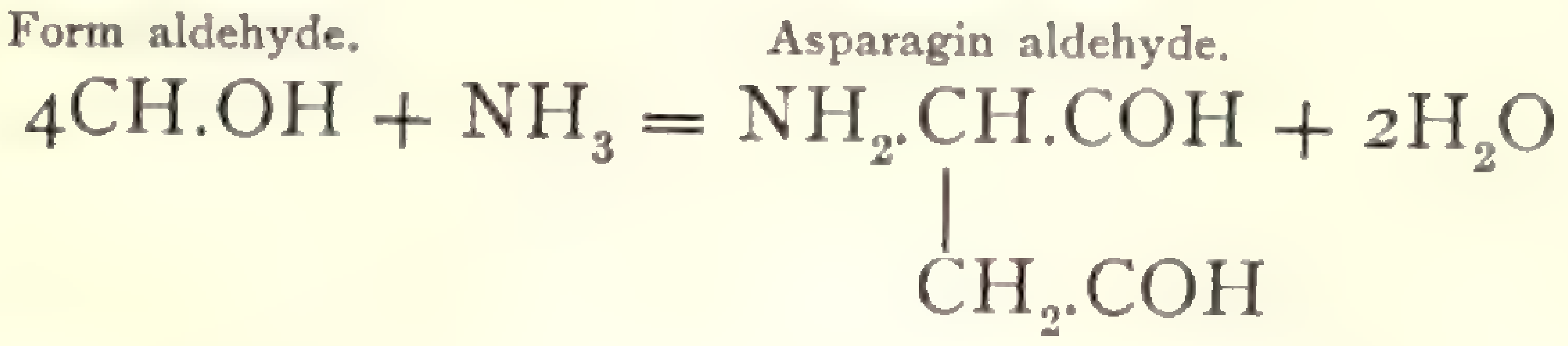
* Since this was written two pieces of work have appeared which have overthrown by experience the above exposed view of Schimper, previously advanced by Osc. Müller (Landw. Versuchsst., 1887). The one is of Kinoshita (Bulletin of Agricultural College in Tokio, 1895 : 2), the other the above quoted memoir of B. Hansteen (Berichte deutsche bot. Ges. 1896).

† l. c., 145.

‡ Eine Hypothese über die Bildung des Albumins in Pflüger's Archiv, **22**: 503. 1880.

He supposes then, that this reaction is performed in three phases :

The first consists in the production of asparagin aldehyde from the form aldehyde



$$\overset{\text{Form aldehyde.}}{4CH.OH} + NH_3 = \overset{\text{Asparagin aldehyde.}}{\begin{array}{l}NH_2.CH.COH \\ \ \ | \\ CH_2.COH\end{array}} + 2H_2O$$

The second is the condensation of several molecules of asparagin aldehyde into a body now unknown.

$$3\left\{\begin{array}{r}H_2N.CH.COH \\ CH_2COH\end{array}\right\} = \overset{\text{The unknown body.}}{C_{12}H_{17}N_3O_4} + 2H_2O$$

Löw maintains that this body is produced by the destruction of two or four aldehydic groups (COH).

At last the body thus obtained gives protein by the action of hydrogen and H_2S derived from decomposed water and reduced sulphuric acid :

$$6\,C_{12}H_{17}N_3O_4 + 6\,H_2 + H_2S = \overset{\text{The simplest formula of protein.}}{C_{72}H_{112}N_{18}SO_{22}} + H_2O.$$

This hypothesis was strongly criticised by E. Schultz.* Among his objections one deserves special notice, namely, that in scientific explanation such indefinite factors as the "vibrations of living molecules of protein" must be carefully avoided—a factor to which Löw has taken recourse again in his new hypothesis, concerning the formation of sugar.†

It would be useless to go into detailed criticism of this hypothesis; but concerning the first reaction it may be remarked that while the given construction could be applied to the fungi, which can assimilate ammonia as easily as other nitrogen compounds, it could not apply to green plants, or at least to the phanerogams, since we know that they receive not only their nitrogen in the form of nitrates, but we have also certain data indicating the nature of the first transformation of these nitrates. And this is the only point in the whole process on which experimental researches have thrown some light.

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* Ueber die Eiweissumsatz in Pflanzenorganismus—Landwirtschaftliche Jahrbücher, 1885 ; Just's Berichte, 1888. The hypothesis proposed by this author to supply the place of that of Löw seems to me, indeed, more remote from probability than the criticised one.

† Berichte deutschen chem. Gesellsch., **22** : 482.

The purely chemical investigation of A. Emmerling* has shown that oxalic acid can decompose very dilute solutions of potassium or calcium nitrate by combining with the base and setting free the nitric acid.† The most interesting consequence of this fact is the behavior of the oxalic acid in the presence of nitrate of potassium and carbonate of calcium. Pure oxalic acid does not dissolve calcium carbonate, because of the formation of thin insoluble layers of calcium oxalate, which preserves it from the action of the acid. But as soon as we add a small quantity of nitrate of potassium it is decomposed, and the nitric acid, set free, dissolves the calcium oxalate, producing calcium nitrate, which is again decomposed by the prevailing mass of oxalic acid. Thus a small quantity of potassium nitrate can by its ferment-like action assist in dissolving a large amount of calcium carbonate.

Thus the observation of Schimper concerning the disappearance of nitrates in the green cells of leaves and the simultaneous accumulation of crystals of calcium oxalate, lead to the conclusion that the first change to which nitrates are exposed in leaves consists in setting free the nitric acid.

The nitric acid ought then to be the starting point of our construction. Such a reaction is presented in the hypothetical equation of A. Mayer, which represents this reaction :

$$\underset{\text{A carbohydrate.}}{C_{37}H_{74}O_{37}} + 6HNO_3 = \underset{\text{Protein without sulphur.}}{2C_{12}H_{19}N_3O_4} + 21H_2O + 13CO_2$$

The first member of this equation is a multiple of CH_2O—the simplest formula of carbohydrates; the first number of the right side is the simplest formula of protein, with the omission of the sulphur.

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* Landwirtsch. Versuchsstationen, **34** : 109.

†R. A. Wood has proved the same for pure water (Amer. Chem. Journal, 1895).

The equation shows that nitric acid and a carbohydrate can produce protein without setting free other products than those which are produced by respiration, namely, carbonic acid and water.

This reaction is otherwise represented by Berthelot and André, whose considerations are based upon chemical researches concerning the amount of calcium carbonate, oxalic acid and proteids at different periods of life of a plant and in its different parts.*

Comparing the formula of formic aldehyde with that of oxalic acid, we see that when the latter is produced from the former it would have an excess of hydrogen :

$$2CH_2O + 2H_2O = C_2H_2O_4 + H_6$$

If we take into consideration the equality of volumes of carbonic anhydride and oxygen by the assimilation, the surplus of hydrogen shows that besides the oxalic acid a substance richer in hydrogen (or poorer in oxygen) than carbohydrates is produced. This may be the protein. The amount of protein found in the leaves of *Rumex acetosa* by the quoted authors answered fairly well to that of the oxalic acid, as needed by such a supposition. The oxalic acid is to be considered as one of the products oxydized, being formed as the reverse side of the reduction of proteids.

A. F. W. Schimper,† agreeing with Emmerling, that amides are the predecessors of proteids, considers in accordance with the expressed view of Berthelot and André the oxalic acid as an indirect product of that process and gives the following equation to explain the formation of amides :

$$\underset{\text{Glucose.}}{C_6H_{12}O_6} + \underset{\text{Nitric acid.}}{2NHO_3} = \underset{\text{Asparagine.}}{C_4H_8N_2O_3} + \underset{\text{Oxalic acid.}}{C_2H_2O_4} + 2H_2O + 3O$$

The three atoms of oxygen are added to the exhaled mass of that element giving a little surplus over the amount of absorbed CO_2, which is generally observed.‡

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*Comptes Rendus, 101 : 24, and 102 : 995, 1043.

† Flora, 1890. (Zur Frage der Assimilation der Mineralsaltzen in der Pflanze, 242.)

‡ *L. c.*, 260.

The above quoted equation is in accord with the views advanced by Holzner,* upon the participation of the oxalic acid, who considers it as a product of proteids, destined to decompose the nitrates, phosphates and sulphates of calcium introduced into the plant and to eliminate that element in an insoluble compound, a view which was confirmed experimentally as to the latter part by Emmerling. The quantitative relation of both oxalic and nitric acids is just the same in the above mentioned equation as needed by the supposition. It is two molecules of HNO_3 for one molecule of oxalic acid.

On the contrary Palladin† claims, that the oxalic acid is produced in the second stage of the reaction by the transition from amides into proteids and represents the process thus:

$$\underset{\text{Asparagin.}}{9\,C_4H_8N_2O_3} + \underset{\text{Glucose.}}{9\,C_6H_{12}O_6} = \underset{\text{Protein (without S).}}{C_{72}H_{112}N_{18}O_{22}} + 9\,C_2H_2O_4 + 23\,H_2O + 2H_2$$

This supposition does not contradict that accepted by Schimper's formulae; Berthelot and André found that the amount of oxalic acid in the form of soluble oxalates in fresh leaves is nearly equal to that found with calcium thus agreeing with the last equation in which, as well as in that of Schimper one molecule of oxalic acid is produced for two atoms of nitrogen, the amount of oxalic acid combined with calcium (supposing that the nitric acid is absorbed by the plant only as calcium nitrate) being thus equal to its surplus over that element.

Such are the chief facts and the attempts to give an account of them. Trying to go somewhat further in this line the best way seems to me to start (as did Pfeffer) with a per cent. composition of both asparagin and a proteid, for instance legumin, calculated as to the equal amount of nitrogen, and to compare their difference with the percentage composition of a carbohydrate, as, *e. g.*, glucose. We have then the following table of which the first three columns are taken from Pfeffer's memoir ‡ the fourth is obtained by multiplying the percentage composition of the glucose with 0.91 in order to reduce its amount of carbon to the same number as represented in the third column :

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* Flora, 1867.

† Berichte deutsche bot. Ges. **5**: 326.

‡ Pringsheim's Jahrbücher, **8**: 355 *seq.* 1872.

Asparagin.	Legumin.	Difference.	Glucose.
C = 64.9	C = 36.4	+ 28.5	C = 28.5
H = 8.8	H = 6.1	+ 2.7	H = 4.7
N = 21.2	N = 21.2		
O = 30.6	O = 36.4	− 5.8	O 37.8
125.5	100.0		71.0

The difference between the two latter columns is

$H = 2 = H_2$
$O = 43.6$ or nearly $2\frac{2}{3}$ O

which give together H_2O and about $1\frac{2}{3}$ O in surplus for each two atoms of N. In other words the transition from amides to proteids, supposing that the lacking elements are supplied by the carbohydrates, is a reduction. It may be, that this part of the synthesis requires the action of those strongly reducing bodies, which were found in the leaves by Schimper; for, as we know, the amides can be accumulated in darkness while the formation of proteids from them is connected with the action of light upon chlorophyll as stated by Schimper. The new experiments in this line* show indeed, that if the plants have at their disposition an abundant supply of carbohydrates they can produce this synthesis in darkness : This does not appear strange, for they are then placed in the same conditions which exist generally in fungi, the needed reducing energy being supplied by the oxidation of the surplus of sugar.

Another point to be considered is the origin of the oxalic acid. We have seen that Schimper as well as Berthelot and André consider it as an indirect product of the synthesis of proteids and this opinion generally prevails among physiologists in opposition to the older supposition of Holzner, who considered it as the result of their decomposition. On the other hand we see that oxalic acid is produced at nearly every decomposition or splitting of the proteid molecule.

The only fact which can throw any light about the question

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*The above quoted pieces of work of Berthold, Hansteen and Kinoshita; W. Zaleski in Ber. deutsch. bot. Ges. **15** : 536.

as to the true origin of oxalic acid in plants, is the distribution of that compound in different organs of the plant. This point, as regards the oxalic acid bound to the calcium and forming insoluble crystals, was very carefully studied by Schimper * and by Kohl.†

The former distinguishes four types of calcium oxalates, adding a new one to the three proposed by Schimper: (1) The *primaries* are found in buds and are produced independently of assimilation; (2) The *secondaries* originate in the chlorophylic parenchyma and are connected with assimilation; (3) The *tertiaries* are found in the neighborhood of sclerenchymatous cells and also in fruits and seeds, where reserve-substances are accumulated; (4) The *quaternaries* are deposited in leaves in the autumn and remain there.

Beginning now with the fourth category, we know, that in the autumn new proteids are not formed in leaves, but on the contrary, the larger portion of those that constitute the protoplasm of the cells, is dissolved and transferred into the stem; this transfer is most probably accomplished after the splitting of the proteids into amides and carbohydrates. The most abundant production of oxalic acid in plants is then due to the decomposition of proteids. It can be objected that the larger part of oxalic acid could have been produced at any earlier period of development of leaves being then in form of soluble compounds and that the sudden appearance of a large amount of crystals in autumn is due to the supply of calcium. But we have no reason for supposing that large amounts of calcium are brought into the leaves at a time when their vital functions are declining.

In reality the above quoted results of Berthelot and André concerning the distribution of oxalic acid in *Rumex acetosa*, containing a large amount of soluble oxalates seems to contradict our conclusion; but the same authors found in other plants (*Amarantus caudatus*, *Chenopodium quinoa*) quite opposite relations, and they add, after having presented the results of analysis of the first of these plants: "that these latter plants show quite a different mode of generation and physiological functions" (Ceci accuse un mode de génération et des fonctions physiologiques toute differentes†). It is then not improbable that such plants as *Rumex* and other "oxalic" plants represent some deviation from normal conditions.

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* The above quoted article in Bot. Zeitung, 1888.

† Anatomisch-physiologische Untersuchungen über Kalksaltze und Kieselsäure in den Pflanzen, 1889.

The deposition of calcium oxalate in places where thick membranes are formed was noticed long since by Sachs, and it is very natural to associate this phenomena with the production of cellulose. The only known method by which this body can be obtained is through the action of living protoplasm and that suggests the idea, that the cellulose is a product of proteids. A direct transition of other carbohydrates, as sugar or starch, into cellulose was never observed either in the chemical laboratory or in plants ; and we can not imagine the rôle of the protoplasm in this process, otherwise than by supposing that these carbohydrates become constituent factors in the proteid molecule, and from the reduction of this molecule the cellulose is derived.

Now the formation of the crystals of oxalates depends upon two factors : the formation of oxalic acid and the supply of calcium in amount sufficient to bind that acid. Both factors are present in the considered case, for where large amounts of cellulose are deposited by the protoplasm of the cells (as by the formation of sclerenchymatous elements), large supplies of carbohydrates are necessary to form anew the protein molecules of the protoplasm, and the transfer of carbohydrates, as both Schimper and Kohl have shown, is strictly connected with the presence of calcium, which is considered as a "vehicle" for these compounds.

In the same way we can explain the formation of oxalic crystals in buds ; the predominating phenomenon in this young tissue is the division of cells and the production of a large amount of cellulose membrane, which, according to our supposition, involves a large supply of calcium (as "vehicle" for carbohydrates) and the consequent formation of oxalic acid.

As to the oxalates (called secondary), formed in the chlorophylic tissue of the leaves, the conditions are more complicated. Schimper has proved that their formation "is dependent upon light and chlorophyl, but not upon assimilation."† Their amount does not diminish when the plant is put in a position in which it cannot assimilate, as, for instance, is the case when is in an atmosphere deprived of carbonic anhydride. Schimper found that in such conditions proteids cannot be produced by the plant ; thus the formation of these crystals cannot depend upon the formation of proteids. But although the formation of proteids is one of the essential functions of the leaf parenchyma, we know that another process is taking place in them, and that is respiration. Whether or not we accept the view that the respiration of plants is essentially based upon the spontaneous dissociation of proteid molecules (the intra-molecular respiration), we cannot overlook the analogy between the function of carbohydrates as respiratory material in animals and plants.

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* Comptes Rendus, 102: 1044.

† Bot. Zeitung, 1888, 69.

When the assimilation goes on normally, the cellulose deposited by the decomposition of the proteid molecules augments the mass of the plant, while the assimilated carbohydrates are used partially in the reconstruction of that molecule, partially burnt out, the same as in the animal organism a product of proteids—the fat—is stored up, when the animal is abundantly fed with carbohydrates. But, if the production of carbohydrates is not sufficient, the material produced by the proteids is burnt the same as fat is burnt in animal organism under the same conditions. The amount of proteids decomposed by respiration, and consequently that of the oxalates is nearly the same, whether assimilation takes place or not ; only in the last case the growth of the plant is hindered, for the part of the protein molecule deprived of nitrogen, will be oxydized into H_2O and CO_2, while its part containing nitrogen will increase the amount of amides, which, as is known, is really observed in such conditions.

The dependence of the secondary oxalates on light and chlorophyl can be explained by the proteid influence of these factors upon the transpiration or, in other words, upon the ascension of water from the soil towards the leaves, and the introduction of salts of calcium in quantities necessary to bind the produced oxalic acid. This dependence of the secondary oxalates upon transpiration was directly proved by Schimper*; the independence of the primary ones from that function, proved by the same investigator, can be explained from the above statement, namely, that the necessary amount of calcium is never lacking in this case, because these organs being unable to produce the carbohydrates indispensable for their growth, these bodies must be transferred to the other parts of the plant, and that transfer is, as we know, fulfilled in form of a combination with calcium.

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* *Loc. cit.* 89.

We can thus consider a large part if not all the oxalic acid produced in plants* as a final product of decomposition of proteids in a certain degree analogous to the carbamide in animals. The analogy is increased by the fact that the oxalic acid is either ejected from plants in the fallen leaves, or reduced to a state of insolubility from which, in most cases, it is never brought forth. It is thus an excretion, comparable to the carbamide in animals. If these inductions are true, we can propose a very general question : *What is the reason for such a difference between terminal products of decomposition of the proteid molecule in animals and in plants* ?

We find a fact of equal generality which enables us to answer this question : that is, the reduction of nitric acid, common to all chlorophylic plants. We do not know exactly the stages through which this reduction goes, but it is not to be doubted that one of them must be nitrous acid (NHO_2). The salts of this acid are found in plants only in very small amounts, but that is easily explained by their quick transformation into other compounds.

The action of nitrous acid or its anhydride upon the compounds of an amidic type is very characteristic. When the reaction is violent the place of the amido group (NH_2) is taken by the hydroxyl group (HO), the nitrogen being set free ; in other circumstances all the nitrogen remains combined with the radical, producing a diazo compound, while the hydrogen of the amido group and a part of the hydrogen of the radical is combined with the oxygen of the nitrous acid.

These two modes of action of the nitrous acid are exemplified by the following equations :

If we take the oxamide (the amide of the oxalic acid) the result will be oxalic acid, nitrogen and water :

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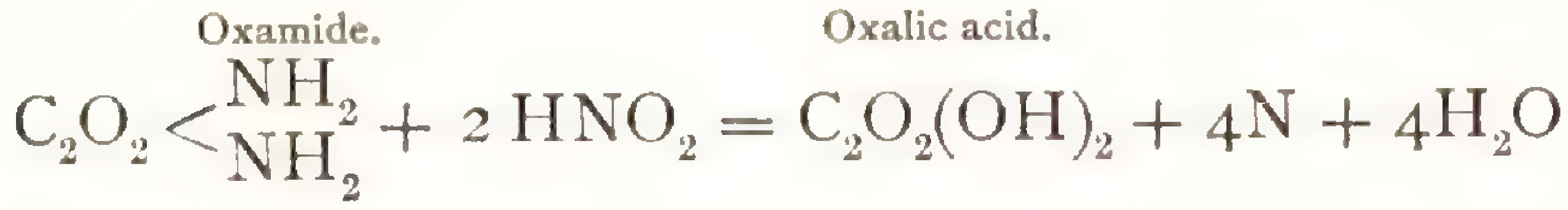
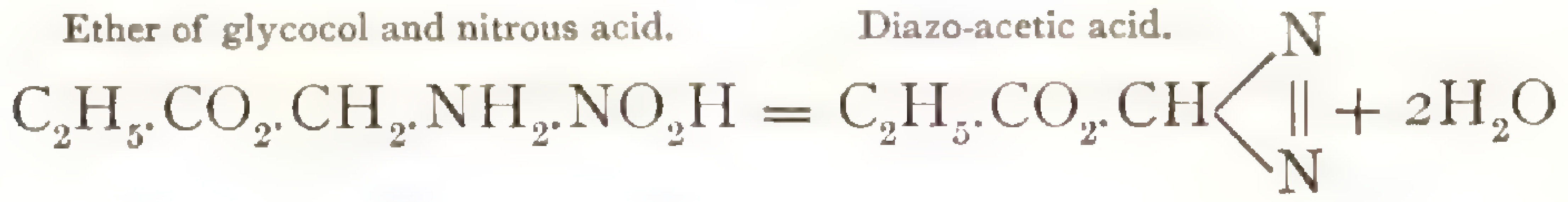
* Schimper admits that the whole amount of oxalic acid in plants need not necessarily have the same origin (*loc. cit.* 69).



Oxamide. Oxalic acid.

$$C_2O_2<\begin{matrix}NH_2\\NH_2\end{matrix} + 2\,HNO_2 = C_2O_2(OH)_2 + 4N + 4H_2O$$

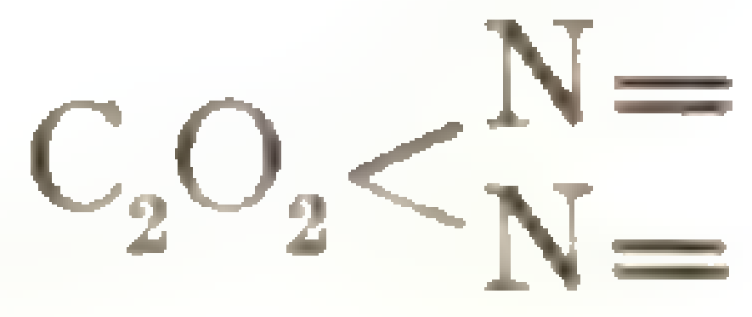
But, if we act cautiously with hyponitrous acid upon the glycocol (the amido-acetic acid) we obtain at first the ether of that acid and of the glycocol, which afterwards yielding water gives the diazo-acetic acid, as shown by the equation



Ether of glycocol and nitrous acid. Diazo-acetic acid.

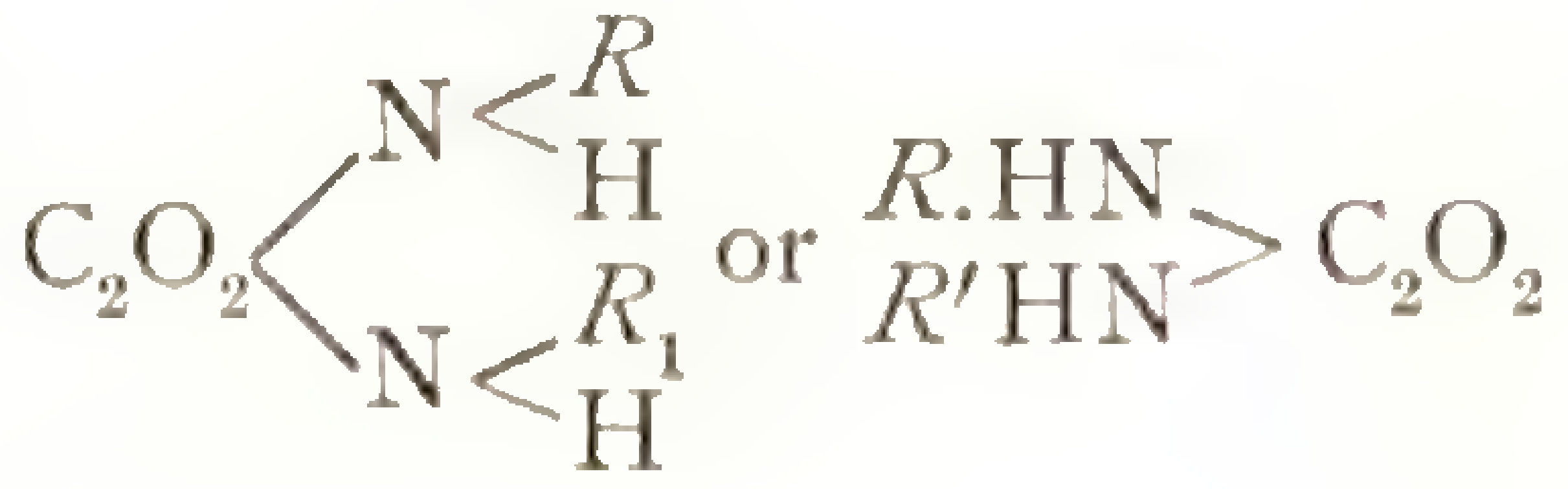
$$C_2H_5.CO_2.CH_2.NH_2.NO_2H = C_2H_5.CO_2.CH\langle\begin{matrix}N\\\|\\N\end{matrix} + 2H_2O$$

We have seen that the chemical functions of the proteids compel us to admit the group



$$C_2O_2<\begin{matrix}N=\\N=\end{matrix}$$

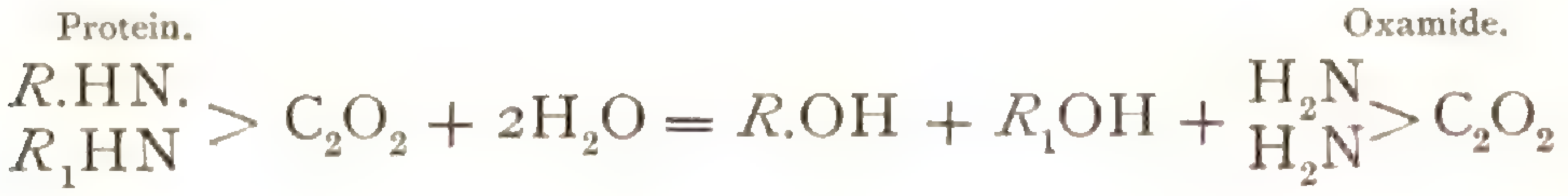
as the basis of the molecule of these bodies. It is simply the oxamide group, introduced in one of the above given equations. Each of the two atoms of nitrogen has in that group two free units of affinity. If we denote with R and R_1 two univalent radicals containing C, H, O, N and S, we can represent a molecule of protein as follows:



$$C_2O_2\langle\begin{matrix}N<\begin{matrix}R\\H\end{matrix}\\N<\begin{matrix}R_1\\H\end{matrix}\end{matrix} \text{ or } \begin{matrix}R.HN\\R'HN\end{matrix}>C_2O_2$$

A molecule of such structure can give according, to the reagents which will act upon it, either carbamide or oxalic acid.

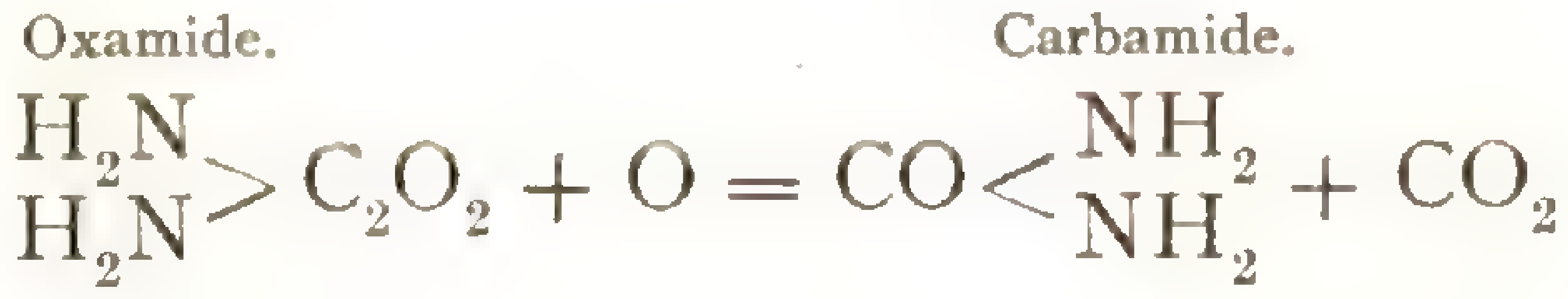
By hydrolysis it will be split at the places of junction of the radicals R and R_1 with the atoms of nitrogen, and the result will be as follows:



Protein. Oxamide.

$$\begin{matrix}R.HN.\\R_1HN\end{matrix}> C_2O_2 + 2H_2O = R.OH + R_1OH + \begin{matrix}H_2N\\H_2N\end{matrix}>C_2O_2$$

the oxamide then gives as known by oxydation carbonic anhydride and carbamide

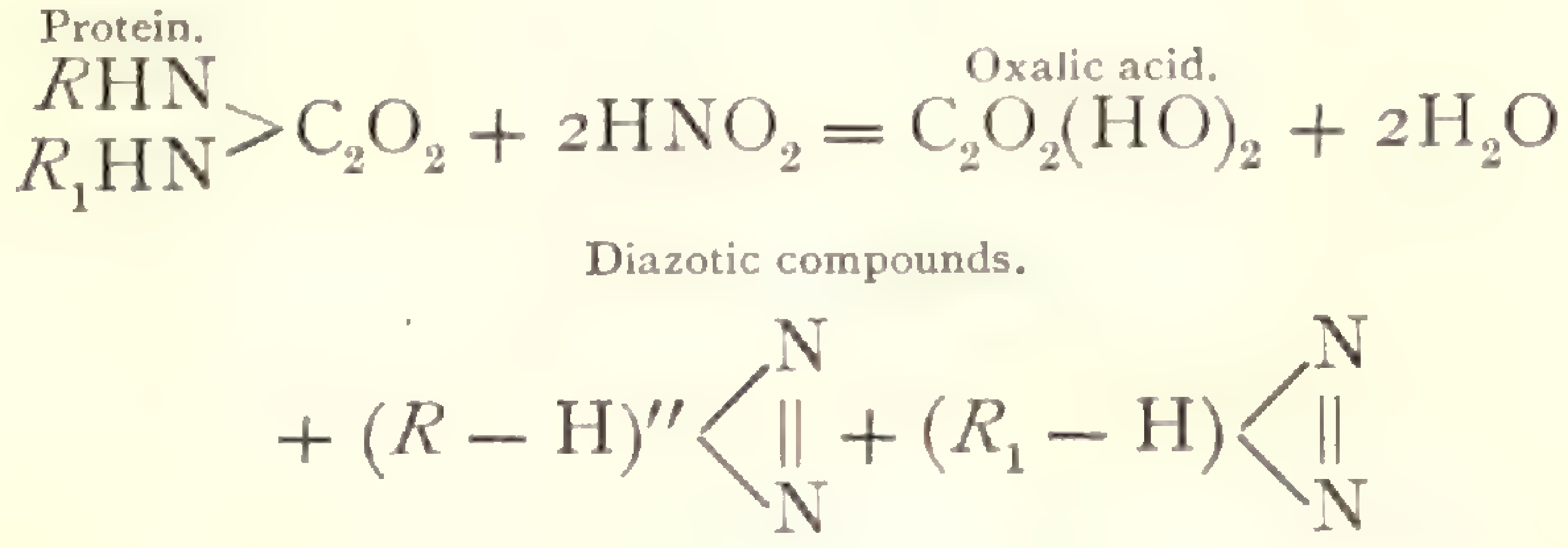


Oxamide. Carbamide.

$$\begin{matrix}H_2N\\H_2N\end{matrix}>C_2O_2 + O = CO<\begin{matrix}NH_2\\NH_2\end{matrix} + CO_2$$

The remainders of the first equation R.OH and R_1OH are poorer in nitrogen than protein. It is the type of disaggregation of proteids in animals.

If the nitrous acid will act on such a molecule, it will split at the junction of the nitrogen atoms with the group C_2O_2, as was the case in the above quoted reaction with oxamide and nitrous acid; but if the reaction proceeds very slowly the nitrogen will not be set free. Keeping the analogy with the above given reaction of NHO_2 and the glycocol we can represent the supposed process as follows:



$$\overset{\text{Protein.}}{\begin{matrix}RHN\\R_1HN\end{matrix}}>C_2O_2 + 2HNO_2 = \overset{\text{Oxalic acid.}}{C_2O_2(HO)_2} + 2H_2O$$

$$\overset{\text{Diazotic compounds.}}{+ (R - H)''\left\langle\begin{matrix}N\\ \| \\ N\end{matrix}\right. + (R_1 - H)\left\langle\begin{matrix}N\\ \| \\ N\end{matrix}\right.}$$

In other words each of the radicals R and R_1 losing one atom of hydrogen (which is used for the production of water with the oxygen of the nitrous acid) and developing to a new value of affinity, combines with the now formed diazo group $(-N=N-)$.

This ought to represent the transformation of the proteids in plants, which, as we know, *do not lose their nitrogen.*

The known fact that the secondary and the tertiary amides of the aromatic series do not give diazotic compounds with nitrous acid,* cannot be quoted against the possibility of the supposed reaction. For (1) The diazotic compounds of the fat series differ much from those of the aromatic one as well in their constitution as in their properties, and (2) As we know very little about them the argument based upon the ignorance of such a reaction loses its strength. Then, we must remember that the reaction to which the production of diazotic compounds is due, belongs to those in which all is dependent upon the conditions of action of the agents; we are, indeed, encouraged to suppose that the subtleness of the transition in plants surpasses even the most delicate chemical operations in our laboratories that we can imagine.

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* From the secondaries nitroso-amides are obtained; the tertiaries give compounds with a nitroso group (NO) on the benzolic nucleus (Confr. Ladenburg, Handwörterbuch der Chemie, 3: 194).

The above presented hypothesis lacks direct proof. My own repeated attempt to produce the reaction of dissociation supposed for plants, either through action of gaseous N_2O_3 or nitrite of potassium (KNO_2), or soda ($NaNO_2$) in presence of any acid (hydrochloric or acetic) upon the albumin did not give any definite result.* This is certainly no objection against the validity of the hypothesis. The conditions for such a reaction are probably very delicate and very complicated and remain to be discovered. But among recent pieces of work there are some which give an indirect support to this hypothesis.

Drexel † obtained through action of hydrochloric acid and stannous chloride on albumin a base (*lysatine*, $C_6H_{13}N_3O_2$) which gives carbamide when treated with baryta water. This reaction shows, as the author deduces, that carbamide is not a product of oxydation, but of hydrolysis. The same result is reached through physiological deductions.‡ A fact of greatest interest for physiologists is that the arginine ($C_6H_{14}N_4O_2$) obtained by Schultze from the seeds of *Lupinus* and differing from lysatine only by the addition of NH, gives also carbamide with baryta water.§ It proves that a wide difference in the constitution of animal and vegetable proteins is not the ground for the different terminal products, but only the difference of the chemical processes in both.

On the other hand Buchner and Curtius, using soda nitrite on the product of the reaction of hydrochloric gas and alcohol on gelatine, obtained a diazotic compound, which differs very strikingly from other compounds of this kind by its stability; thus, *e. g.*, it can be boiled without decomposition. This compound was obtained in a large amount (150 grains from 400 grains of gelatine) and ought to be the only product of the reaction. The investigation of the products from the action of iodide upon these compounds leads the authors to one of the following formulae :

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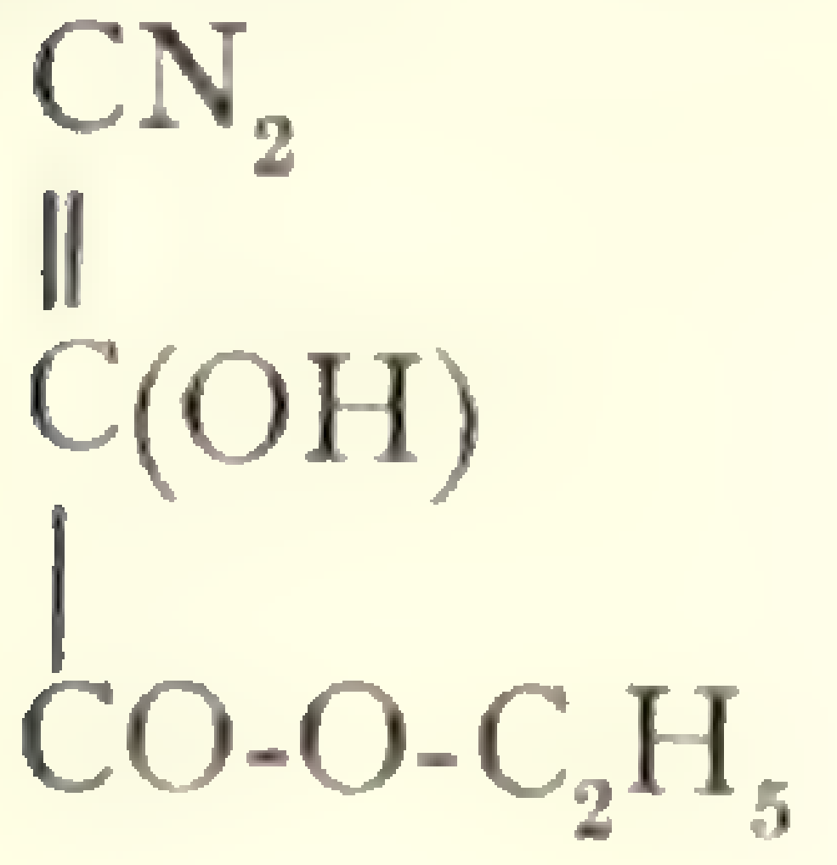
* In the first case it seemed not to be produced by any change in the albumin; in the second xanto protein was the constant product of the reaction.

† Ueber die Bildung des Harnstoff aus Eiweiss in the Berichte deutsch. chem. Gesellsch., 1890: 3096. Confr. also Siegfried, Zur Kenntniss der Spaltungsproducten der Eiweiss *Ibid*, **24**: 418. 1891.

‡ *Cf.* A. Gautier, Chimie de la cellule vivante, 1895, passim.

§ Ber. deutsch. chem. Ges. **24**: 1098. 1891.

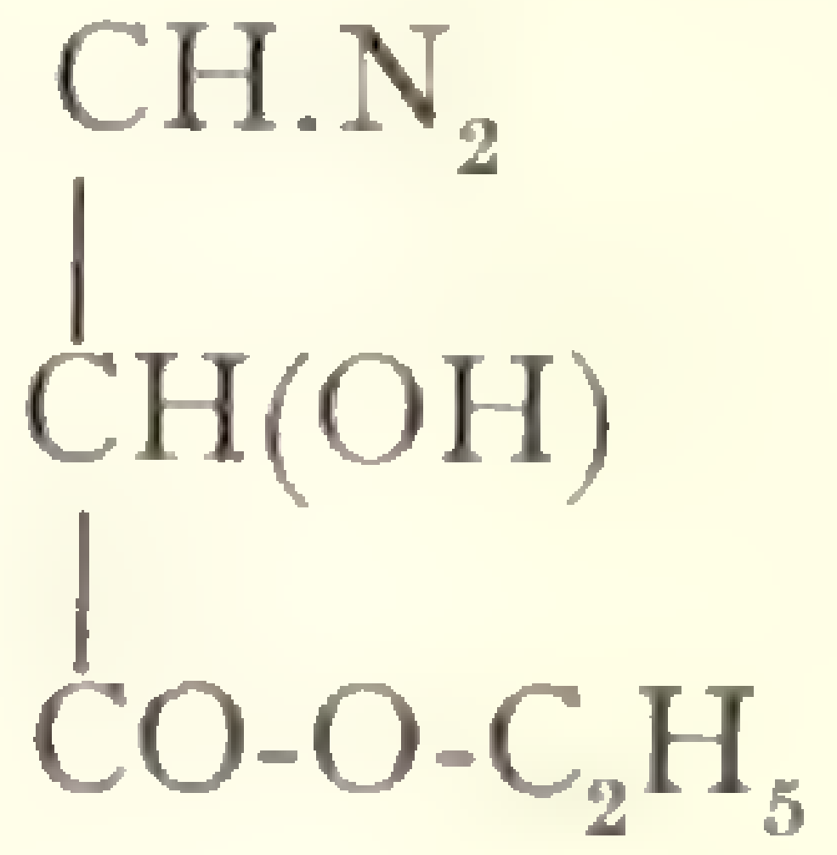
Ether of the diazo-oxy-acrylic acid.



$$\begin{array}{l} CN_2 \\ \| \\ C(OH) \\ | \\ CO\text{-}O\text{-}C_2H_5 \end{array}$$

or

Ether of the diazo-lactic acid.



$$\begin{array}{l} CH.N_2 \\ | \\ CH(OH) \\ | \\ CO\text{-}O\text{-}C_2H_5 \end{array}$$

These facts show the possibility of such a reaction, as was suggested both in animals and in plants which explain two very general physiological facts, viz.:

1. That the terminal products of disintegration of the proteid molecule are different in plants and in animals.

2. That green plants cannot use the ammoniacal compounds for the production of proteids, while the mediating links in that process are amides, compounds with hydrogenized nitrogen and not with the oxydized one as is found in nitric acid.

The first is explained by the fact that in the animal organisms there are no conditions for the production of nitrous acid, while in plants it might be produced as one of the stages of deoxidation of the nitric acid. The second, by the necessity of that acid for green plants and thus the impossibility of omitting that stage of deoxidation and of beginning the process with compounds containing only hydrogenized nitrogen. (In fungi, as we know, the process must be different, and it is proved that they can use the amidic ammoniacal compounds as supply of nitrogen.)

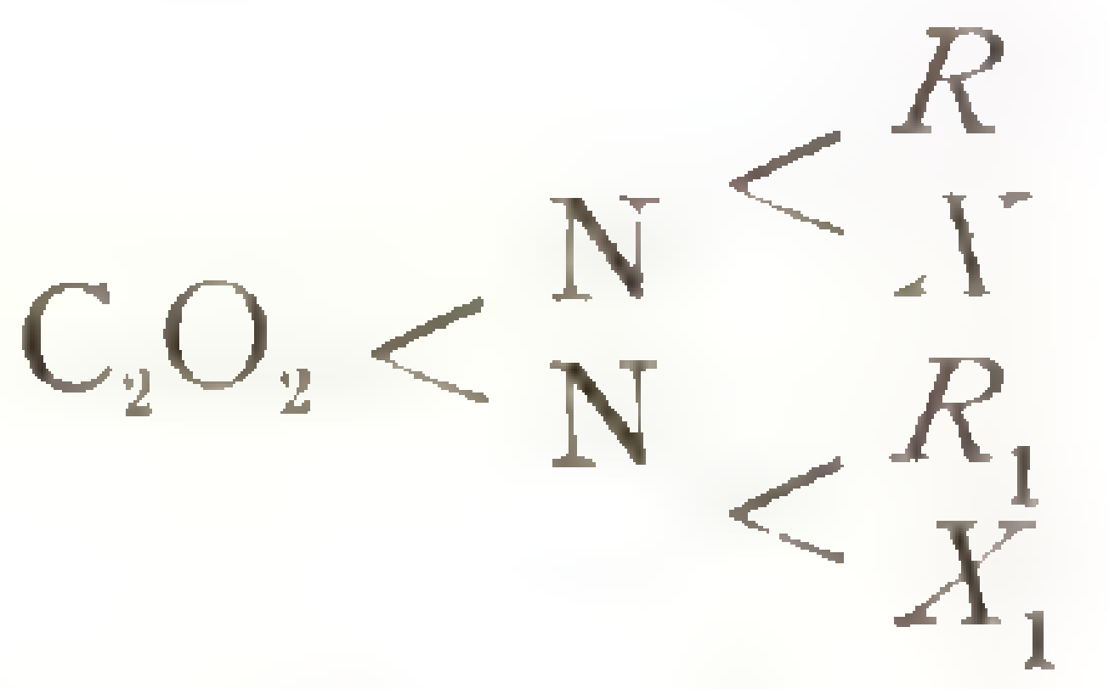
The logic of chemistry seems to impose upon us this hypothesis with almost irresistible necessity. All that we know about the chemical process in organisms teaches us that these processes are produced so as to pass through all the consecutive stages and compounds mediating between the initial and the terminal one. If we represent the transition from nitric acid to the amides through all known stages of reduction we obtain the following series of groups:

Nitro.	Nitroso.	Diazotic.	Hydrazines.	Ammonia and amides.
$-NO_2$	$-NO$	$-N=N-$	H_2N-NH_2	NH_3

We see thus that the diazo compounds take the middle place between the oxidized nitrogen of acids and the hydrogenized of hydrazines and amides. It is not improbable that the hydrazines are the agents of many reductions, such as the reduction of silver, which, as Löw and Bokorny have shown, constitute a property of living plasma, of those proteids in which the process of disaggregation and regeneration of molecules is still going on.

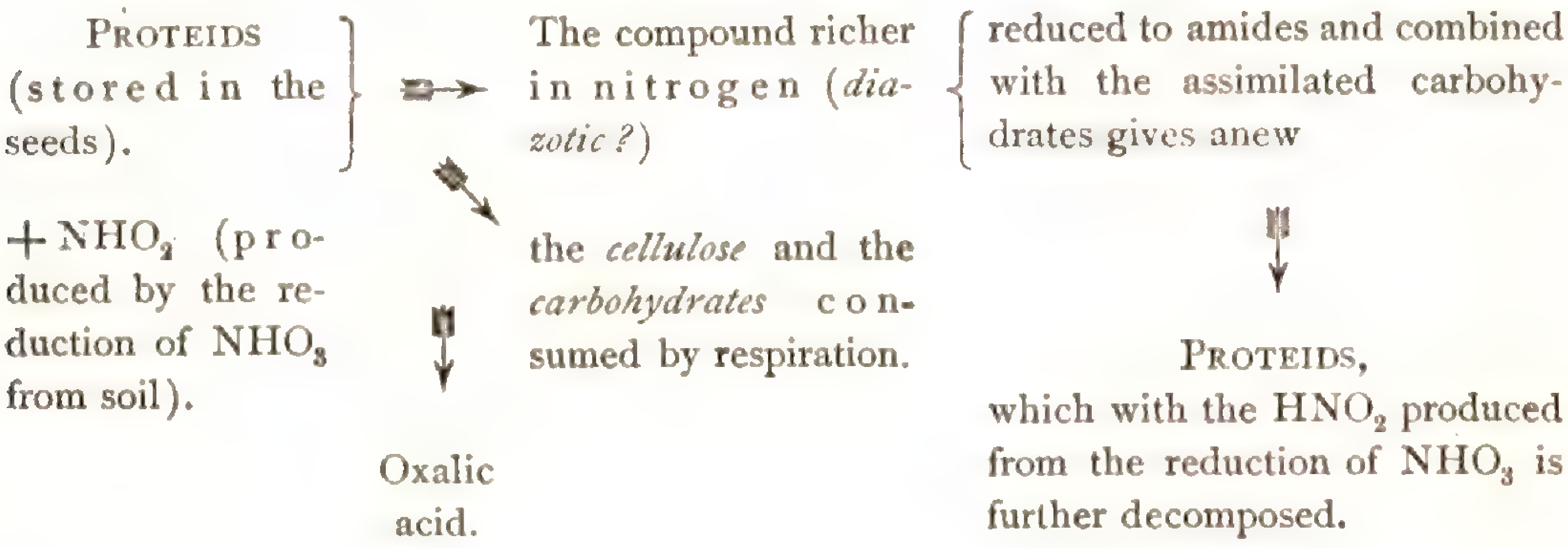
This regeneration is produced by means of compounds with diazotic groups like those formed in the last equation, and it is easy to see that every process of disintegration is accompanied by an enrichment with organic nitrogen, and as every decomposition of proteids is only a stage to their reconstruction in larger amount, the above discussed question upon the origin of oxalic acids appears under quite a new light; in most parts of the plant (excluding the autumnal leaves) both decomposition and reconstruction of proteids are connected processes taking place at the same time.

I have had already occasion to notice the analogy between the production of cellulose in plants and that of fats in animals. It is natural to suppose that both are produced by some groups of atoms set aside during the above discussed reaction. If in the formula of protein we put groups of atoms X and X_1 containing only carbon, hydrogen and oxygen, instead of NH, it assumes the following structure:



$$C_2O_2 < \begin{matrix} N < \begin{matrix} R \\ X \end{matrix} \\ N < \begin{matrix} R_1 \\ X_1 \end{matrix} \end{matrix}$$

These groups of atoms, being set free in each of the two supposed reactions, would originate the fatty acids in the case of animals, the cellulose or starch in the case of plants. Thus we can represent the continuous process of formation and destruction of proteids in plants as follows:



PROTEIDS (stored in the seeds).

The compound richer in nitrogen (*diazotic?*)

reduced to amides and combined with the assimilated carbohydrates gives anew

PROTEIDS, which with the HNO_2 produced from the reduction of NHO_3 is further decomposed.

+ NHO_2 (produced by the reduction of NHO_3 from soil).

Oxalic acid.

the *cellulose* and the *carbohydrates* consumed by respiration.

It is necessary to notice that this diagram does not require a constant relation between the amount of protein and that of carbohydrates in plants, a relation which really does not exist. The quantitative relation between compounds containing nitrogen and those without it in plants is within certain limits dependent upon the relation of assimilation to the amount of nitric acid absorbed from the soil. The greater the amount of assimilated carbohydrates, the less the carbohydrates, which are derived from proteids, will be burnt. On the contrary, when the amount of assimilated carbohydrates is not sufficient the relative amount of nitrogen in the plant will rise, and since in such conditions proteids cannot be regenerated—that surplus will consist of amides and other nitric compounds of a non-proteid character. Something like this we find in the above quoted results of the analysis of plants grown from seeds in darkness. (*Ante*, p. 39.)

But the amount of cellulose (and other soluble carbohydrates) cannot exceed a certain maximum in respect to nitrogen, and that maximum corresponds to such a state in which the assimilated carbohydrates make up all the loss for respiration, a state probably reached in plants when the conditions of feeding are normal.

Some chemical and physiological facts indicate that in the proteid molecule there are groups of atoms closely connected together and containing each 6 atoms of carbon. That number is basal for the carbohydrates found in organisms and fatty acids, the most common in animals, containing a multiple of that number (the stearic $C_{18}H_{36}O_2$; the oleic $C_{18}H_{34}O_2$). The amides, which are produced in organisms, or through the action of chemical agents upon the proteids contain generally less than 6 atoms of carbon and the most typical of them, leucine is the amido-capronic acid — $C_6H_{13}NO_2$. Only the less defined compounds obtained by Schützenberger (and called by him leucines) seem to make an exception to this rule, but we do not know whether these are chemical individuals or mixtures. All these and many other physiological facts oblige us to admit a near connection between proteids, fats and carbohydrates, and although the transitions from one group to another cannot yet be accomplished in the laboratory, there is no doubt that it is accomplished continually in the organisms themselves.

NEW YORK.

Note on Asplenium Glenniei Baker in Synopsis Filicum, 2d Ed. p. 488

By C. W. Hope

In August, 1898, I had the pleasure of making the acquaintance of Professor Underwood, while he was examining certain genera of ferns in the herbarium of the Royal Gardens at Kew, and I then drew his attention to what I considered a remarkable instance of a locally plentiful Himalayan fern being sparingly found in a few localities in Mexico and in Arizona, U. S. A., having been described from the American specimens as a new species, and I asked leave to send my views as to this fern for publication in the Bulletin of the Torrey Botanical Club.

In the first edition of the *Synopsis Filicum*, under *Asplenium fontanum* Bernh., *A. exiguum* Bedd., from the Nilgiris, is mentioned as being a less divided form, with narrow fronds and ebeneous rhachis, and the authors go on to say that a similar plant had been gathered in Mexico by Mr. Glennie. But in the second edition Mr. Baker set up a new species—"*A. Glenniei* Baker, Hab. Mexico, *Consul Glennie*, Bourgeau, 252.—Very like some of the forms of *fontanum*." When at Kew, in 1888, I pointed out to Mr. Baker and Colonel Beddome that the specimens of *A. Glenniei* in the Royal Herbarium were merely a common north-west Indian fern, which I had been calling *A. exiguum* Bedd.—Mr. Baker objected that there was a wide interval between Mexico and the western Himalaya, and Colonel Beddome remarked that neither the Himalayan nor the Mexican plant could be his because the fronds were not prolonged at the apex. Prolongation of the rhachis into a "naked tail often bearing a young plant" was a character given by Beddome in his original description of the species, in the "Ferns of S. India," published in 1873, though this entry was omitted from his Handbook of 1883, where he degraded the plant to the rank of variety. This proliferous form of the tip I found, on returning to India, to be a normal, though perhaps not an invariable character of the Himalayan plant, as it is to be also of *A. micropteron* Baker, Syn. Fil. 488,—" rhachis much produced beyond lamina, rooting at the tip, Hab. San Luis, 7000, Pearce." But *A. micropteron* differs materially in having a flattened and broadly and interruptedly winged rhachis, and also in the cutting of the pinnae, and must be considered quite distinct. Mr. Baker's type specimen of *A. Glenniei* (*vide* Ic. Fil. *pl. 1648*) has not a prolonged and proliferous rachis; but in the British Museum there is one plant among *A. fontanum*, ticketed—" U. S. Pacific Coast Flora (new to U. S.) var.—' Conservatory,' Huachuca Mts., Arizona, August 8, 1882, Lemmon Herbarium, Oakland, California," which is exactly the northwest Himalayan fern, and it is proliferous on the pinnae throughout, and also at the apex of the frond. And there are in the same herbarium two specimens from America, named *A. Glenniei* Baker, which are exactly the Himalayan plant. Also, there are in the Calcutta Herbarium three specimens named *A. Glenniei*, from America, one or two of which is the Himalayan fern, the third is not.

The Mexican plant had been named *Athyrium gracile* by Fournier, in his Fil. Mex. 102, published in 1872, and Mr. Baker gave this as a synonym of his *Asplenium Glenniei*, being obliged to reject *gracile* as the specific name because there was already *Asplenium gracile* Fée, and also another plant so named by Pappé and Rawson. Fournier's plant is in the " Herbier de la Commission scientifique du Mexico, recueilli par M. Bourgeau 1865–66." Lemmon's plant, collected in Arizona, 1882, was identified by Baker as *A. Glenniei*, and was cited as *A. Glenniei* Baker, by Eaton in the BULLETIN OF THE TORREY BOTANICAL CLUB, 1883, p. 29, and some specimens collected by Pringle, and by Lloyd, in Mexico in 1886 and 1894, were also so named.

I find no difficulty in separating the Himalayan and North American plant from *A. fontanum* Bernh.; but it is not without hesitation that I came to the conclusion that it is the same as Beddome's Nilgiri plant. Beddome found his plant in only one station, and he then thought it nearly allied to *A. comptorhachis* Kze., which Baker unites with *A. lunulatum* Sw. Mr. Gamble has a dozen plants ticketed *A. exiguum*, which he got near Barliár, on the Nilgiris, 2500 ft. alt., all small and narrow, and with prolonged rhachises. I have seen no S. Indian specimen nearly so large as the Himalayan plant reaches. Of the latter-named plant I wrote the following description about eight years ago:

Plants isolated, or united in tufts by the matted roots; *caudex* erect, short; *stipes* ½–2½ in. l., rarely more than 1½ in., densely tufted, soft, castaneous, clothed at base with linear hair-pointed dark-colored scales, more or less so clothed upwards, scales gradually changing upwards to soft hairs, *frond* linear-lanceot late, bipinnatified, never nearly bipinnate, 2–9 in. l., ½–1¼ in. br., *rhachis* flattened, winged, green in upper two thirds, the castaneous color of stipes extending farthest up the inferior side, and sometimes in patches; *pinnae* 20–25-jugate, oblong with an expanded base or cuneate, sometimes leafy and then obliquely triangular and less cut, subpetiolate, blunt, costae inconspicuous, undulate laterally, lower pinnae more distinct, shorter but scarcely narrower at base, sometimes trifoliate in shape; segments 3–6-jugate, having 1–6 teeth according to number of veinlets, lower margins concavely cut or scooped out, lowest anterior much cut away; color dark green; *veins* one to each segment sometimes forking near tips; *sori* costular, one at the base of each segment, two or more in lowest anterior; *frond* often very attenuate upwards and then rooting at tip; segments sometimes all truncate or marginate at apex and there proliferous."

The Himalayan habitats I have noted are: The PUNJAB: in *Kuller* 7–9000 ft. alt., one station; in the *Simla Region* 6–9000 ft., not common, but gathered by seven persons separately. In the NORTHWESTERN PROVINCES: in the *Dehra Doon Dist.*, in Iannsar 7000 ft., in the Hill Sanitarium of Mussooree 55–7000 ft., locally plentiful; in *Garhival* 6–7000 ft., not often seen; in the *Kumaun Dist.* 5–10000 ft., in various places.

As to distribution—besides the Mexican and U. S. A. habitats already mentioned—I have noted Waugtu in the Sikkim Himalaya, *Hook. fil. & Thoms.* 1847; the S. Indian stations for Beddome's plant already mentioned: China—Monpine, *David,* 1889; Mengtez; Yunnan, *W. Hancock,* 1893; "shady rocks, very local."

If the Nilgiri (S. India) plant (Bedd. F. S. 1, *t. 146*) be admitted to be the same as the American and Himalayan plants (Beddome added "Himalayas" as a habitat in his Handbook), then Beddome's name *A. exiguum,* being the older, must have priority over Baker's name, *A. Glenniei.* *A. Zunnanense* Franchet in Bull. Bot. Soc. France, 1885, p. 28, which Mr. Baker, in Ann. Bot., 1892, placed as a variety of *A. fontanum* Bernh., near var. *exiguum,* and of which Beddome in his Suppt. of 1892, after describing it, says: "Seems hardly to differ from typical *fontanum,*" must, I think, also come under *A. exiguum.*

I have not gathered *A. fontanum* Bernh., but I possess numerous specimens, collected by five contributors in the northwestern Himalaya, from Hazára eastward to Kumaun, and have seen many more collected by them and many others from Afghanistan to west Nepal, and, except as to size, I can say that the specimens are very uniform. Mature plants vary from 2½ to 12 inches in height (including rootstock) according to attitude and exposure. The largest I have seen were from Kashmire at an altitude of 4500 ft.; one I have is 12 inches high; and I have a note of another plant which had 16 fresh fronds covering, as dried, an area of 15 × 10 inches. There is never any resemblance to, or passage into *A. exiguum* Bedd. The Indian specimens agree with the description of *A. fontanum* in that they are all distinctly *bipinnate;* *A. exiguum* (or *Glennici*) is never more than *bipinnatifid.* *A. fontanum* is always of a pale grass-green color—almost yellowish sometimes: *A. exiguum* is always dark green. And, corresponding to the cutting and venation, the position of the sori in the two plants is quite different. In *A. fontanum* the sori are all placed in the pinnules and segments, on the veinlets, without any relation to the costa of the pinna: in *A. exiguum* they are in a row on each side of and close to the costa, curving outwards with the veins towards the segments. *A. fontanum,* so far as I know, never has fronds with the rhachis prolonged and rooting at the point; nor have I seen it proliferous at the pinnae. Both these features are characteristic of *A. exiguum.*

A great deal of the European material called *A. Halleri* Willd. (under *Aspidium*), which by some botanists is reduced to *A. fontanum,* is more like *A. exiguum* than like *A. fontanum,* but the fronds of *A. Halleri* are broader for their length, and the sori do not lie along the costa or secondary rhachis. Willdenow said of *A. Halleri:* "Ab *A. fontano* ab unde distincta species." *A. exiguum* varies considerably in width of frond and pinnae and in cutting, but the variations are all away from the direction of *A. fontanum.* Indeed I should find it difficult to point out identical characters, or even resemblances, between the two plants.

A. exiguum is abundant in many places within the municipal limits of Mussooree, the Hill Sanitarium in the District of Dehra Doon, Northwest Provinces, India—where I have chiefly observed it—at altitudes of about 5500 to almost 7000 feet, on (usually) limestone, moss-covered rocks in the forest, generally with a northern aspect. It spreads itself out like aster, the prolonged fronds bending backward until they hang their tips in the moss, seeking for cracks or crevices, or earth, in which to root. The fronds last for two years at least, living through the winter in frost and snow, and through the succeeding dry, hot season, in a shriveled and apparently dead state until the rainy season comes in June or July, when they uncurl, and then frequently, if they have not already done so, produce young plants on their tips, or on their pinnae. This is followed by the springing up of fresh fronds from the same roots, which are not generally proliferous in that season, so far as I have seen. Judging from the numerous herbarium specimens I have seen *A. fontanum* of the Himalaya has a more erect habit than *A. exiguum*, and is never proliferous.

The late Mr. H. F. Blanford, F.R.S. (*vide* his "List of the Ferns of Simla, in the N. W. Himalaya between Levels of 4500 and 10,000 feet," Jour. Asiat. Soc. Bengal, **57**: 294–315. 1888), said that *A. exiguum* was rare in the neighborhood of Simla. In Mr. J. S. Gamble's collection I have found three sheets—with eleven specimens—from Simla. On the five days' march from Simla to Bági, eastward on the Great Thibet road in 1886, I saw only two or three specimens at about 8000 feet altitude, but the fern may be more abundant off the road at lower levels. In 1861 I saw one plant of *A. exiguum* at Naini Tál, in Kumaun, N. W. Himalayas, by the side of the lake, but none anywhere else or on the way to Almora, thirty miles northward; and there is not much record of it from the eastward of Mussooree. There is no passage from *A. exiguum* to the next species, *A. varians* Hk. and Gr.

KEW, Nov. 1898.

New Species of Fungi

By Chas. H. Peck

Lepiota coerulescens

Pileus thin, convex, obtuse or slightly umbonate, squamulose, whitish, the squamules and the center brownish, flesh and surface of the pileus becoming blue in drying; lamellae thin, close, free, white, becoming blue in drying; stem slender, equal, brownish, annulate, the annulus membranous, persistent, externally tinged with blue when dry; spores elliptic, 7 μ long, 5 μ broad.

Pileus 1.5–2 cm. broad; stem 3–5 cm. long, 2 mm. thick. Ohio. C. G. Lloyd.

The species is closely allied to *Lepiota cristata*, from which it is easily separated by its assuming blue tints in drying.

Lepiota gracilis

Pileus thin, convex or campanulate, somewhat umbonate, white, the center and the scales formed from the ruptured cuticle blackish brown; lamellae close, ventricose, free, whitish; stem long, slender, floccose or fibrillose, blackish brown, the annulus membranous, persistent, conspicuous, blackish brown on the lower surface; spores broadly elliptic, 6–7 μ long, 4 μ broad.

Pileus 6–10 mm. broad; stem about 2.5 cm. long, scarcely more than 1 mm. thick.

Black humus in woods, Elmsdale, Canada. September. J. Dearness.

A small, graceful species which when young is probably wholly covered by the blackish brown cuticle, but by the expansion of the pileus this soon ruptures, except in the center or on the umbo, revealing the white surface beneath and forming spot-like scales.

Tricholoma piperatum

Pileus rather thin, firm, dry, convex, obtuse or subumbonate, virgate with innate brownish fibrils, varying in color from grayish brown to blackish brown, sometimes with greenish or yellowish tints, flesh white or whitish, taste acrid; lamellae broad, close, rounded behind, adnexed, whitish or yellowish; stem generally short, equal, solid, silky, slightly mealy or pruinose at the top, white or slightly tinted with yellow; spores elliptic, 6–7 μ long, 5 μ broad.

Pileus 4–7 cm. broad; stem 5–7 cm. long, 6–12 mm. thick.

Woods, Massachusetts, G. E. Francis; Pennsylvania, Charles McIlvaine.

The central part of the pileus is sometimes a little darker than the rest. The peppery or acrid taste is very distinct and remains in the mouth many minutes. This and the innately fibrillose character of the pileus are distinguishing characters of the species. The plants appear from September to November.

Hygrophorus Morrisii

Pileus thin, convex, obtuse or umbonate, covered by a viscid separable pellicle, even, grayish brown or blackish brown, flesh whitish; lamellae subdistant, adnate or slightly decurrent, often slightly eroded or uneven on the edge, white; stem rather slender, equal or slightly tapering downward, solid, straight or flexuous, flocculently furfuraceous, pallid or brownish; spores elliptic or oblong, 10–12 μ long, 5 broad.

Pileus 1.5–2.5 cm. broad: stem 4–6 cm. long, 3–5 mm. thick.

Under pine trees, Waltham, Mass. November. G. E. Morris.

This species is closely related to *H. pustulatus* Fr., but differs from it in the entire absence of pustules or papillae from the uniformly colored pileus and in having a solid stem which, though somewhat scurfy, is not rough or scabrous with black points. The presence of concolorous papillae on the pileus and of black points on the stem of *H. pustulatus* is given by Fries special emphasis in his description of this species. In Icones he describes the lamellae as very entire (integerrimae) which character is not applicable to our plant. These differences seem to me too important to be disregarded and I take pleasure in dedicating this interesting American species to Mr. George E. Morris, who sent me numerous specimens of it in fine condition.

Volvaria umbonata

Pileus thin, campanulate, becoming convex or nearly plane, prominently umbonate, distinctly striate, slightly viscid when moist, silky when dry, white; lamellae moderately close, free, not extending beyond the margin of the pileus, pale flesh color; stem equal or slightly thickened at the base, glabrous, solid, white, the ruptured membranous white volva persistent, irregularly split or lobed on the margin and forming a shallow cup at the base of the stem; spores broadly elliptic, uninucleate, variable in size, 5–7 µ long, 4–5 µ broad.

Pileus 2–3 cm. broad; stem 5–6 cm. long, about 4 mm. thick.

Lawns and grassy places, Ohio, Lloyd.

The species is most closely allied to *Volvaria media* (Schum.) Fr., from which it is distinguished by its larger spores and the striate margin of the pileus. In our plant the striations sometimes extend to the umbo. *Volvaria emendatior* (B. & C.) is described as having a white umbonate pileus with striate margin, but it is a much larger plant with the lamellae extending beyond the margin of the pileus and with cymbiform spores 12 µ long.

Clitopilus irregularis

Pileus thin, irregular, sometimes eccentric, nearly plane, glabrous, reddish brown, flesh white; lamellae rather broad, subdistant, decurrent, whitish becoming tinged with flesh color; stem short, solid or spongy within, externally fibrous, colored like the pileus, usually caespitose; spores pale flesh color, elliptic, 6–7 µ long, 3–4 µ broad.

Pileus about 2.5 cm. broad; stem about 2.5 cm. long, 2–4 mm. thick.

Manured ground, London, Canada. October. Dearness.

Leptonia aeruginosa

Pileus thin, convex, umbilicate or centrally depressed, striate, aeruginous; lamellae broad, subdistant, adnate, aeruginous, tinged with flesh color when mature; stem slender, glabrous, hollow, colored like the pileus; spores angular, 7.5–10 µ long, generally containing a single large nucleus.

Pileus 1.5–2.5 cm. broad; stem about 2.5 cm. long, 2 mm. thick.

Shaded places in woods, Oxbow river, Canada. August. Dearness.

This small mushroom is quite conspicuous by reason of its peculiar and unusual verdigris color. This fades with age to an ashy green hue.

Flammula aliena

Pileus thin, flexible, broadly convex, umbilicate, dry, glabrous, slightly striate on the margin when old, grayish or pale grayish-brown, flesh white, fibrous; lamellae thin, subdistant, arcuate, decurrent, ochraceous brown; stem firm, fibrous-striate, solid, slightly tapering upward, colored like the pileus, covered at the base with a dense white tomentum; spores ferruginous-brown, globose, 5 μ broad.

Pileus 3–5 cm. broad; stem 5 cm. long, 4–6 mm. thick.

Gregarious on partly buried anthracite coal, Mt. Gretna, Pa. September. C. McIlvaine.

The species is peculiar in its color and habitat. In the dried specimen the lamellae have assumed a brown color with no ochraceous tint. Mr. McIlvaine remarks that it is an edible species, dries well and is excellent when cooked. Its relationship is with *F. anomala* Pk., but it is a larger plant with darker color and a different habitat.

Galera capillaripes

Pileus subcampanulate, obtuse, a little broader than high, even, glabrous, hygrophanous, faintly striatulate and pale ferruginous when moist, paler or buff color when dry; lamellae rather broad, distant, adnate, pale ferruginous; stem very slender, flexuous, glabrous, colored like the pileus; spores elliptic, 8–12 μ long, 6–7 μ broad.

Pileus 4–6 mm. broad; stem 2–3 cm. long, less than 1 mm. thick.

Lawns and grassy places, Ohio. May and June. Lloyd.

This might easily be taken for a dwarf form of *Galera tenera* (Schaeff.) Fr., from which its capillary flexuous stem and more distant lamellae serve to distinguish it.

Crepidotus latifolius

Pileus very thin, submembranous, sessile, suborbicular, 3–6 mm. broad, hygrophanous, striatulate when moist, white and slightly pubescent when dry, flesh white; lamellae very broad, suborbicular, 5 or 6 times as wide as the thickness of the flesh, subdistant, extending beyond the margin of the pileus, white becoming pale ferruginous with age; spores globose, 5–6 μ broad.

Gregarious on much decayed wood, Ohio, Lloyd.

Agaricus maritimus

Pileus very fleshy, firm, at first subglobose, then broadly convex or nearly plane, glabrous, sometimes slightly squamose with appressed spot-like scales, white becoming dingy or grayish brown when old, flesh whitish, quickly reddening when cut, taste agree-able, odor distinct, suggestive of the odors of the seashore; lamellae narrow, close, free, pinkish becoming purplish brown with age, the edge white; stem short, stout, firm, solid, equal, sometimes bulbous, white, the annulus delicate, slight and easily obliterated; spores broadly elliptic, purplish brown, 7–8 μ long, 5–6 μ broad.

Pileus 5–20 cm. broad; stem 2.5–5 cm. long, 1.5–2.5 cm. thick.

Sandy soil near salt water, Lynn, Nahant and Marblehead, Mass. June to December. R. F. Dearborn.

This is a very interesting and an excellent mushroom. Dr. Dearborn writes that he has used it on the table for fourteen years and that it is the only mushroom that he has ever eaten in which the stem is as good as the cap. He considers it the most hearty and satisfying of all the numerous species that he has ever eaten. Both its taste and odor is suggestive of the sea. The latter is quite strong, and perceptible by one riding along the road by whose side the mushrooms are growing. They sometimes grow in semicircles and attain a larger size in warm weather than in the colder weather of autumn. They are most abundant in August. The flesh when cut or broken quickly assumes a pink or reddish hue on the freshly exposed surface. This is a very distinctive character and with the maritime habitat makes the species easy to recognize. Another species, *Agaricus haemorrhoidarius* Kalchb. exhibits a similar change of color in its wounded flesh, but it is of very rare occurrence with us, does not, so far as ascertained, grow near the sea, has a darker cap and a longer hollow stem. The stem in the maritime mushroom is short and solid. Its collar is very slight and easily destroyed.

Agaricus magnificus

Pileus fleshy, thick, convex, becoming nearly plane or centrally depressed, glabrous, often wavy and split on the margin white or whitish, often brownish in the center, flesh 1.5–2 cm. thick in the center, thin on the margin, white, unchangeable; lamellae numerous, rather broad, close, free, ventricose, white becoming dark purplish brown with age, never pink; stem firm, stuffed with cottony pith, bulbous or thickened at the base, fibrillose, striate, minutely furfuraceous toward the base, annulate, pallid or whitish, the annulus thin, persistent, white; spores small, elliptic, 5–6 μ long, 3–4 μ broad.

Pileus 5–15 cm. broad; stem 10–15 cm. long, about 2.5 cm. thick.

Gregarious or cespitose; thin woods, Mt. Gretna, Pa. August. McIlvaine.

A large fine species distinguished from its near allies by the absence of pink hues from the gills. Mr. McIlvaine remarks that it has an anise-like flavor and odor and that when young the whole fungus is tender and high-flavored but when full grown only the caps are edible.

Agaricus argenteus Braendle *in litt.*

Pileus thin, convex becoming nearly plane, slightly silky or glabrous, pale grayish white or grayish brown, shining with a silvery luster when dry, the margin sometimes striate, at first incurved, often revolute when old, flesh whitish, becoming blackish where cut; lamellae close, free, at first brownish, becoming blackish brown or black with age; stem short, glabrous, solid, often narrowed toward the base, the annulus slight, evanescent; spores broadly elliptic, 7–10 μ long, 6 μ broad.

Pileus 2.5–5 cm. broad; stem 2.5–4 cm. long, 4–8 mm. thick.

Lawns and grassy places in rich soil. Often associated with *Stropharia bilamellata* Pk. After rains from April to November. Washington, D. C., F. J. Braendle.

This is a small mushroom, peculiar in having the young lamellae of a dark color and in the absence of any pink hues. The lamellae sometimes become moist and manifest a tendency to deliquesce. The drying specimens emit a strong but not unpleasant odor. Mr. Braendle says that their edible quality is excellent and that it is not impaired by drying.

Psathyra microsperma

Pileus ovate or subhemispherical, becoming deeply convex or subcampanulate, obtuse, even, hygrophanous, brown when moist, paler when dry, slightly floccose when young, flesh brownish; lamellae thin, close, adnate, brown; stem equal, hollow, fibrillose; spores brown, elliptic, 5–6 μ long, 3–4 μ broad.

Pileus 1–2.5 cm. broad; stem 2.5–3 cm. long, 2–3 mm. thick.

Cespitose about old stumps, Ohio. April. Lloyd.

The white floccose tufts of the pileus and the white fibrils of the stem are easily destroyed in handling the specimens. The species is similar in the ornamentation of the pileus to *Psilocybe senex* Pk.

Coprinus laceratus

Pileus thin, at first ovate and covered with a white separable floccose coat which soon separates into scales or patches and finally disappears, then campanulate, striate nearly to the center, much torn or lacerated on the margin, pale buff becoming darker with age; lamellae thin, close, free, white when young, becoming black; stem equal or slightly thickened at the base, striate, hollow, white; spores elliptic, 12–15 μ long, 8–10 μ broad.

Pileus 2.5–4 cm. broad; stem 5–7.5 cm. long, about 4 mm. thick.

Cespitose on manure mixed with shavings, Ohio, Lloyd.

The glabrate mature specimens resemble very pale forms of *C. micaceus* Fr. Young plants resemble *C. quadrifidum* Pk., but the mature plants do not split to the center as in that species, and the spores are larger than in it.

Polyporus admirabilis

Pilei tufted, large, more or less imbricated, nearly entire centrally depressed or subinfundibuliform, glabrous, white or slightly tinted with pale yellow or cream color; pores minute, rotund, whitish, with thin dissepiments; spores flattened, orbicular, 5–6 μ broad.

Pilei 10–15 cm. broad, united at the base and forming tufts 30 cm. or more in diameter.

Wood of apple trees, Riverside, Maine. August and September. H. P. Burt.

This is a very beautiful and attractive species which is referable to the tribe Merisma. Mr. Burt remarks that the fresh tufts of clear white trumpet shaped pilei are suggestive of a cluster of giant calla lilies.

Craterellus corrugis

Pileus soft, fleshy, flexible, at first clavate, obtuse, flesh colotinted with violet, soon obconic or turbinate, broadly convex or truncate, glabrous, somewhat irregular with an obtuse margin corrrugated by the extension of the hymenial wrinkles, ochraceous buff or pale ochraceous when fresh and moist, somewhat rufescent when dry, sometimes leprously whitened in the center, flesh white, very soft, soon shrinking and leaving the pileus hollow, the hymenium colored like the pileus, conspicuously corrugated or wrinkled when fresh or moist, the wrinkles less conspicuous when dry; stem short, equal or tapering downward, colored like or a little paler than the pileus; spores white, 8–10 μ long; 4–5 μ broad.

Pileus 2.5–5 cm. broad; stem 1.5–2.5 cm. long, 6–8 mm. thick.

Thin oak woods, Massachusetts. September to November. G. F. Francis.

This species is closely related to *C. clavatus* (Pers.) Fr. from which it differs in its coloration, larger size and smaller spores. Sometimes the plants are united at the base, forming small clusters. The species is also liable to be confused with *Craterellus pistillaris* Fr. and *Clavaria pistillaris* L., unless the distinguishing characters are carefully observed.

Fistulina firma

Pileus fleshy, firm, flexible, dimidiate or reniform, convex, covered with a minute somewhat tufted tomentum, buff verging toward isabelline, flesh very white; tubes short, 1–2 mm. long, whitish, abruptly terminating at the stem; stem firm, solid, somewhat irregular, cinnamon brown above, paler below, white within; spores minute, subglobose, about 3 μ broad.

Pileus 6–7 cm. broad; stem 2.5 cm. long, 8–12 mm. thick.

Among fallen leaves, near Manchester, N. H. October. Mrs. A. M. Hadley.

This is evidently a very rare and very distinct species. Only two specimens were found and these were united at the base. They were apparently growing from the ground where it was covered with fallen leaves, but probably the base of the stem was connected with some root or piece of buried wood. Most of the described species have more or less red in the color of the pileus, but in this there are no red tints. The tomentum is of such a character as to give the pileus a pulverulent appearance, but it is not at all dusty nor easily separable. The flesh is pure white, of a uniform but firm texture and a slightly acrid flavor. The tubes are very minute and very short. The mass is rounded next the stem, ending abruptly and not at all decurrent.

Helvella nigra

Pileus irregular, cupular, 1.5–2 cm. broad, externally velvety with short few-celled blackish brown or black septate hairs, hymenium even, black; stem 1.5–2 cm. long, solid, deeply sulcate and lacunosely pitted, velvety, black; asci 8-spored, 150–200 μ long, 12–15 μ broad; spores elliptic, 15–20 μ long, 10–12 μ broad, usually containing a single large shining nucleus.

Ashes of an old camp fire, Mt. Katadin, Maine. September. F. L. Harvey.

This species is externally black and everywhere clothed with short thick black hairs except on the hymenium, but the inner substance is white. It is peculiar in having a cup-shaped though wavy and irregular ascomate or pileus. It is possible that this may become reflexed or deflexed with age, but I have seen no such specimens. The stem is rather long and conspicuously sulcate and lacunose, and on this account I have referred the species to the genus *Helvella* rather than to *Acetabularia*. The hymenium is sometimes suffused with a white pruinosity.

Microglossum obscurum

Clubs 8–12 mm. long, about 2 mm. broad, compressed, obtuse, glabrous, tapering below into a stem which is about as long as the club, olive brown or blackish brown; asci clavate, 100–112 μ long; spores fusiform, slightly curved, hyaline, 12–15 μ long, 4–5 μ broad.

Gregarious or cespitose in thickets, Canada. August. Dearness.

The whole fungus is scarcely more than 2 or 2.5 cm. long. It is smaller and more regular than *M. contortum* Pk., and its spores are more narrow. From the very variable *M. multiforme* (Henn.) Sacc. it is easily separated by its darker color.

Mycological Notes.—V

By Byron D. Halsted

The notes for the present issue have this in common that they are all derived from the results obtained at the Experiment Area of the New Jersey Experiment Station. This test field, sometimes called the "Plant Hospital," consists of two acres laid off into six series, each with four plots and the latter are all divided into six equal parts 11 by 33 feet and called belts. These belts are usually the unit of area for any variation in the method of treatment for the crop in the plot.

Nearly all the vegetable and vegetable-fruit crops are grown, some one or more fungi infesting each being under consideration. In some instances the treatment is entirely with the soil, as for club-root of turnip, or scab of the round potato, but in the majority of cases it is by means of various fungicides applied to the aerial portions of the plant, as in the spraying of beets for leaf blight (*Cercospora beticola* Sacc.) or beans for the pod spot (*Colletotrichum lagenarum* Pass.).

The present season closed the fifth year in the existence of these experiment grounds and during all that time some crops have been grown continuously upon the same land. The work with the turnip club-root (*Plasmodiophora Brassicae* Wor.) is a good instance of this latter fact and may well serve as the first note to be recorded.

Lime for the Club-root of Turnips.—Experiments with lime as a remedy for the club-root, due to the subterranean *Myxomycete*, above named, have been carried out upon one plot, one-twentieth of an acre, and divided into six equal belts. Lime, air slaked, was used upon three of the belts, namely numbers 1, 3 and 5, and at the rate of 150, 75 and 37½ bushels per acre respectively, applied April 24, 1894, to the surface of the ground already prepared for sowing, and thoroughly raked in. Belt number 6 received corrosive sublimate and its consideration will be omitted at this time.

The following table gives the yield of turnips in terms of pounds, and sound and clubbed roots for each of the past five years, no additional lime having been applied during that time.

Year	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6	
	Sound	Clubbed	Sound	Clubbed	Sound	Clubbed	Sound	Clubbed	Sound	Clubbed	Sound	Clubbed
1894	99	2	95	37	75	11	101	14	120	3	127	11
1895	53	1	42	81	135	7	91	36	132	5	79	54
1896	91	0	1	90	87	1	25	65	77	1	22	56
1897	115	0	34	81	117	1			124	4	151	44
1898	86	0	14	77	77	2	64	34	68	1	67	28
Total	444	3	186	366	491	22	281	149	521	14	503	156

It is seen that the amount of diseased roots was much less upon the limed than the unlimed belts. It will be fair to take the first four plots thus dealing with equal areas with lime and without, and under these conditions it is seen that the two limed belts in 1894 gave 13 pounds of clubbed roots to 51 pounds when no treatment was made. The next year shows a greater difference in favor of the limed belts, for in 1895 the yield of diseased roots stood for the treated 8 pounds to 117 pounds for the untreated belts.

In 1896 there was one pound to 155 in favor of the limed belts, and in 1897 the results were practically the same, here, however, one of the check belts was employed for testing the susceptibility of other cruciferae to the *Plasmodiophora*. In 1898 there were two pounds of clubbed roots upon the limed belts to 111 where there was no treatment.

It is seen from the table that the larger amount of lime (belt 1) produced only 3 pounds of clubbed turnips and the half amount of lime (belt 3) yielded 22 pounds, which exceeded the belt with a quarter amount of the lime, namely, 37½ bushels per acre. From this test for five years it seems that 35 bushels of lime per acre is ample to keep the club-root from the land even when the susceptible crop is grown continuously, and two crops each season for at least five years without diminished strength.

By combining the two treated and two check belts the following table is constructed:

	Limited Belts.		Untreated Belts.	
Year.	Sound.	Clubbed.	Sound.	Clubbed.
1894	174	13	196	51
1895	188	8	133	117
1896	178	1	26	155
1897	232	1	68	(162) estimated.
1898	163	2	78	111
Totals.	935	25	501	596

It is seen from this that in a field when the diseased roots outweigh the sound ones, the presence of lime in the soil has the wholesome effect of reducing the disease to near four per cent. of its abundance upon untreated land.

It should be said in addition that under the method of inspection any root that showed the slightest indication of the club-root fungus was excluded from the group of sound specimens and, therefore, this was a discrimination against the treatment, for the diseased roots grown in the limed land were usually only infested to a small extent, while those upon the untreated soil were, as a rule, badly diseased and frequently offensive and of course unmarketable.

Artificial Introduction of Onion Smut.—Smut-infested soil was obtained from a field of a large onion grower in the southern part of the State where *Urocystis cepulae* Fr., had been so fatal that the growing of onions was abandoned. The dry soil thus obtained was added to the open row before the onion seed had been sown and an equal amount upon the covered row, making in all one bushel of the soil to the belt or at the rate of 120 bushels per acre. The seed was sown upon April 23d, and owing to unfavorable weather, germination was slow and the smutted seedlings were first found upon June 8th, and in abundance; but only in the belt where the soil had received the earth from the far away old onion field. A white variety "Pearl" and a red variety "Red Weathersfield" were in alternate rows, and there seemed to be no difference in susceptibility between the two kinds. No smutted onions were found outside of the belt under treatment, which indicates that the disease does not spread rapidly over the field unless the soil is transported, which may be by implements of culture, by winds or the flow of water over the surface of the soil. It is demonstrated that the smut germs can be artificially transferred, very effectively, in small amounts of soil and onion growers should bear the fact in mind in contending with this serious enemy.

The Beet Leaf Blight as a Test for Fungicides.—The beet has been grown in the Experiment Area for the past five years, and is found with us to be one of the best plants for testing of fungicides. There are two fungous diseases that infest the foliage in particular and one of these, *Cercospora beticola* Sacc., is so abundant as to be safely counted upon as being present. The beet plant is a quick growing annual that lends itself especially well to plot experiments; it is low-growing, a habit of considerable importance in spraying; the leaves are large and the disease is conspicuous. Use has been made of nearly all of the full list of the more common vegetables and vegetable-fruit plants and none of them are equal to the beet as a subject for testing the application of fungicides.

During 1894, the first year that beets were grown upon the Experiment Area, only Mangel wurzels were grown and the Bordeaux mixture gave an increase over the check of 26 per cent. In 1896 four kinds of Bordeaux, namely, the ordinary sort made with lime was used as a standard with which was compared three other kinds, namely, soda-bordeaux, potash-bordeaux and ammonia-bordeaux, the lime being replaced with other alkalies, soda, potash and ammonia respectively. In this year the increase in crop accredited to the Bordeaux mixture was 46.5 per cent. for the roots and 77.5 per cent. for the foliage and these were exceeded by the potash-bordeaux which gave 47.5 per cent. gain in roots and 78.5 per cent. of leaves.

In 1897 five varieties of beets were grown in order to study the susceptibility of the different sorts to the blight and the relative effects the various fungicides might have upon them. Out of this list the three following were selected for further use, namely, "Long blood-red," "Swiss chard" and "Long Mangel wurzel" as representing three widely separated types of beets. In passing it may be mentioned that the "Swiss chard" is a form of beet producing small roots and a large development of leaves with broad etiolated petioles that become the edible portion of the plant. This variety blights badly and becomes a better test of the value of a fungicide than beets of the ordinary sort where the root-weight is the deciding point. In short, the experience of the five years in finding the most suitable plant upon which to experiment with fungicides has led gradually to the acceptance of the beets and of these the "Swiss chard" is the one of greatest value.

During 1898, the "Chard" in the belts sprayed with Bordeaux and the soda-bordeaux were conspicuous for their comparative freedom from blight and the latter was somewhat ahead of the Bordeaux mixture. This soda-bordeaux is made according to the following formula: soda, 1 pound (a pound can of Lewis' Lye, for example); copper sulphate, 3 pounds; lime, 5 ounces; water, 30 gallons.

In order to prevent the mixture turning brown (which does not, however, lessen its efficiency but discolors the treated plant) a small quantity of lime is used to neutralize any excess of acid and in this way a permanent bluish-colored solution is obtained. The advantage claimed for this combination is the absence of the large amount of the lime in the ordinary Bordeaux mixture, and it may prove of considerable value in spraying in the fruit garden and vineyard, in particular when the fruit is nearing full size and a clear fungicide does not leave a serious stain upon the fruit. The ease with which the compound may be made and the absence of any danger of clogging the spraying machine commend the mixture to the practical mind.

Susceptibility of Bush Beans to Blight.—Four varieties of bush beans were under experimentation the present season, namely the "Green Flagolet," "Golden Wax," "Early Refugee" and "Saddleback Wax." Two plots were employed, one of them having been in beans continuously since the spring of 1894, two crops each year, and therefore the present season produced the ninth and tenth successive crops. The other plot was of land that had not been in beans for many years, if ever before. Upon the old land the "Refugee" proved the most productive and the "Flagolet" the least, but in spotted pods the results were reversed.

The new land carried a duplicate of the experiment of the one upon the old land, and here the "Refugee" proved the most productive and least susceptible to the disease. If one were seeking a variety to furnish an abundance of disease, for experimental purposes, he could scarcely go amiss in selecting the "Flagolet," while, on the other hand, the "Refugee" would be less acceptable. In foliage the "Flagolet" is exceedingly tender, and from the time the first true leaf appears there is more or less blight in sight.

With the second or autumn crop the same record is made, namely that the "Flagolet" leads all other varieties in susceptibility to the blight. From this and the experience of other years this sort may be considered as one of weak resistant power.

Sweet Corn Smut and Bacterial Disease.—Several varieties of sweet corn were grown, only one of which has shown unmistakable signs of the bacterial disease (*Pseudomonas Stewarti* E. F. Smith), namely, "First of all." This is a very small form, the chief merit of which is its earliness. A second crop grown with the stubble of the first had some of the plants decay away at the base, due to the bacteriosis.

Smut (*Ustilago maydis* DC.) was quite abundant upon the same variety, and like the *Pseudomonas* was rarely met with elsewhere in the plot where four other varieties of sweet corn were grown.

Rotation of Crops a valuable Fungicide.—The fairly well known fact stated in the headline was brought strikingly to the attention of the writer in an experiment with egg-plants. One plot had been in this crop for three successive years, and a half of it was again set to egg-plants for 1898. A duplicate set of plants was placed upon a half plot of land where that crop probably had never been grown. The treatment as to culture and kinds and times of spraying were the same upon the two areas, and the results are shown in the following table:

New Ground.	Marketable.	Small.	Total.
Sound fruits.	130	80	210
Decayed fruits.	21	19	40
Old Ground.			
Sound fruits.	27	15	42
Decayed fruits.	21	45	66

There were five times as many sound fruits upon the new as upon the old land, while the decayed ones were only 16 per cent. upon the new land and 61 per cent. upon the old land. The point of special interest in this connection was that nine sprayings were made with Bordeaux upon one row of each of the half plots and this mixture was not able to keep the plants in the old land in good health. In short, a crop may be continued so long upon the same land that a fungicide may fail to do its effective work, when a resort to some other crop is the only practical method of dealing with the troubles.

Sulphur as a Remedy for Potato Diseases.—Sulphur was added to five of the twenty-four belts of land in one portion of the Experiment Area devoted to tests for a remedy for the Potato Scab (*Oospora scabies* Thax.).

The following table shows the amounts of sulphur per acre, and the time of application:

Plot	I	Belt	2	120 lbs.	1896	480 lbs.	1898 =	600 lbs.	Scab	28.33 %
"	II	"	2	240 "	"	240 "	"	480 "	"	31.66 %
"	III	"	2	600 "	"			600 "	"	36.66 %
"	III	"	6			480 "	"	480 "	"	20.00 %
"	IV	"	6	300 "	1895			300 "	"	10.00 %
				Average						25.33 %

All of the "seed" for the whole field, except that of certain check belts, was soaked twice for one hour each in the standard solution of corrosive sublimate and this operation reduced the scab 8½ %. After making this allowance for the corrosive sublimate the sulphur still further reduced the scab from 52 to 25.33 per cent., or to less than half of the average of the unsulphured belts.

In another part of the Experiment Area there were eighteen belts of land in potatoes, and here the three untreated belts gave 63.30 per cent; of scab. There were four belts to which sulphur was added in equal amounts, but at different times, as follows:

	Belt 1.	3	5	6
In 1896.	240 lbs.	480 lbs.		360 lbs.
In 1898	480 "	240 "	720 lbs.	360 "
Total.	720 "	720 "	720 "	720 "

The average percentage of scab upon these four belts is 12.50% or 50.80% below that upon the untreated belts.

One other test was made with sulphur for potato scab, namely in a plot where turnips had been grown for four years continuously, two crops each year, and sulphur at the rate of 1,200 pounds per acre had been added to one belt in 1896.

After an interval of many years since potatoes had been upon this land the scab was abundant, averaging 80% for the five belts not bearing sulphur, while the treated one showed only 35%, and three quarters of this was upon the row adjoining a belt where the scab was recorded as being 90%.

The three above experiments show that in one instance sulphur reduced the amount of scab after the "seed" had been soaked twice in corrosive sublimate from 52% to 25.33%, in the second case from 63.30% to 12.50% and in the last from 80% to 35%. An average of these results shows a reduction of the scab from 65.10% to 24.27%.

A new Tertiary fossil Moss

By Elizabeth G. Britton

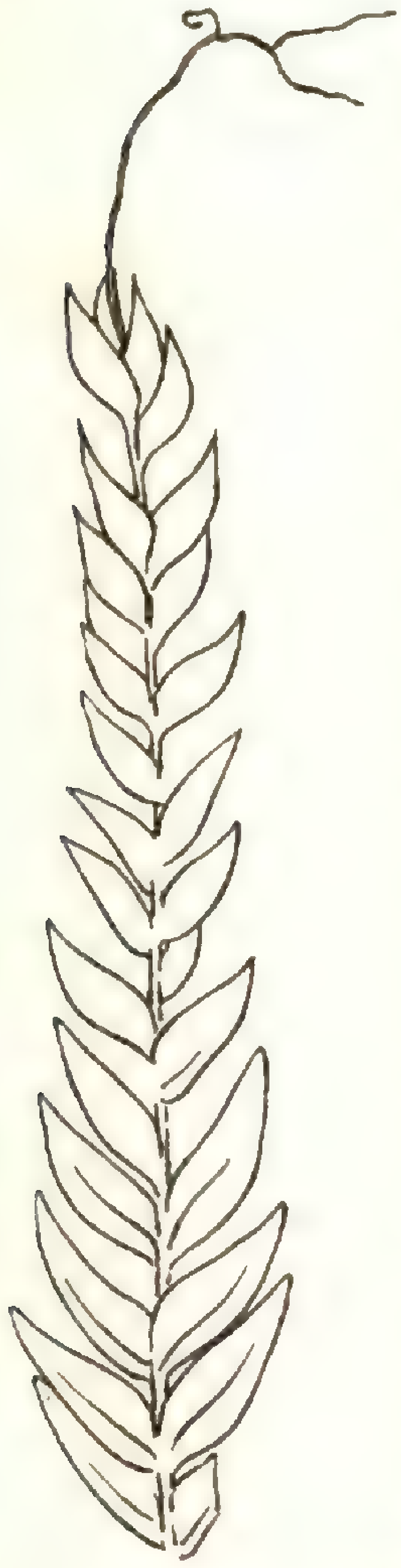
The specimen is number 1765 of the National Museum collection. The material in which it was discovered was obtained by Professor I. C. Russell at a coal mine one mile west of Cle Elum, Kittitass Co., Washington, on July 7, 1897. It came from what is known as the "Roslyn sandstone," and its age is probably lower Miocene or upper Eocene. It was sent with other specimens from the same place to Professor F. H. Knowlton, who supplied the facts given above and who states that it is associated with species of *Lygodium*, *Ulmus*, *Planera* and *Chrysophyllum*, besides a number of other beautifully preserved leaves. He recognized it as a fossil moss and states that it is undoubtedly the oldest fossil species thus far found in this country. He submitted it to me for the determination of its nearest living alliance and Dr. Hollick has searched over the literature of fossil mosses and made the drawing of the specimen. I have dedicated the species to its discoverer.

Rhynchostegium Knowltoni

Stem 1 cm. or more long, showing as a carbonized line at several points and seemingly continuous with a slender, curved, carbonaceous prolongation from its apex, like a leafless stolon. Leaves about 1 mm. long, one third as broad, becoming smaller toward the apex of the stem, more or less two-ranked or flattened, spreading at an angle of 45°, not crowded nor overlapping, unequal at base, the upper half of the leaf rounded at base and covering the stem, the lower narrower and tapering to the stem; vein indicated or suggested more or less clearly in the lower leaves by carbonaceous lines continuous beyond the middle of the leaf, disappearing below the apex which is acute but somewhat blunt, in some leaves quite rounded and broad, not tapering.

Evidently belonging to the Hypnaceae with flattened, apparently two-ranked leaves, suggesting by its tapering, stoloniferous stems, a species related to *Rhynchostegium rusciforme* (Neck.)

Br. & Sch., but differing from that species in its more flattened, less crowded leaves and more slender stems. The species of *Rhynchostegium* are rock mosses with creeping, rooting stems, often stoloniferous and bearing the leaves flattened, ovate or lanceolate and in several species blunt or rounded at apex. The vein is single and extends from one half to three fourths the length of the leaf and the base is either narrow or somewhat decurrent. This fossil species has therefore all the essential characters of the genus, though differing somewhat from all living species.



Dr. Hollick has supplied the following notes: Mosses as fossils are exceedingly rare and as far as I am aware, all the species thus far recorded, with one exception are barren. They are almost confined to the Tertiary and later rocks, although Heer supposed that mosses must have been present in the Jurassic period, on account of the presence, in rocks of the Liassic epoch, of the insect genus *Byrrhidium*, whose living representatives feed upon mosses (Primeval World of Switzerland, English edition, Vol. I., p. 89); and Renault and Zeiller have described, and provisionally referred to the mosses, certain remains from the coal measures of Commentry (Comp. Rend. Acad. Sci. Paris, **100**: 660. 1885). Their presence as early as the Carboniferous period is certainly to be expected, as the Pteridophyta and even the Gymnospermae had appeared upon the scene prior to that time, and their absence from the palaeontological record is probably to be accounted for by reason of their insignificant size and the difficulty of their preservation. Fossil mosses were formerly all included under the genus *Muscites* Brong. and under this genus Unger enumerates nine species. (Genera et Species Plantarum Fossilium, 41, 42. 1850). Schimper in his Traité de Paléontologie Végétale, Vol. I., published in 1869, enumerates about thirty species and includes them all, with the exception of three, in living genera and in some cases refers them to living species. A number have been discovered recently in the Old World in deposits of late geological horizons and referable definitely or provisionally to living species.

The only fossil moss with capsules, which I have been able to find recorded is *Gymnostomum ferrugineum* Ludwig (Palaeont. **8**: 165. *pl. 63, f. 9, 9a.* 1859–61) found in the brown hematite Tertiary deposits of Montabauer. The specimen shows six detached capsules and a few fragmentary branches. Schimper in his Traité de Paléontologie Végétale refers this specimen to the peat mosses and describes it as *Sphagnum Ludwigii*, stating that it is related to *S. cymbifolium* and *S. subsecundum.*

Thus far the only species recorded from America are *Hypnum Hayderi* Lesq., from the Eocene of Colorado (Hayden's Ann. Rept. 1874: 309. 1876; Tert. Fl. **44**: *pl. 5. f. 14–14b*), which is almost certainly a *Lycopodium*, and few fragmentary remains of living species from the Pleistocene deposits of Canada, described by Dawson and Penhallow (Bull. Geol. Soc. Am. **1**: 315, 332. 1890). The specimen now described, is therefore probably the first extinct species and the oldest fossil species recorded from America.

The Washington Botanical Club.

The Washington Botanical Club was organized by a gathering of botanists held at the residence of one of its members, November 11, 1898. The limit of membership was fixed at twenty, and it was determined that the meetings should be for the present, at least, of a distinctly social and informal nature, with free scope for discussion and the general interchange of ideas. At a subsequent meeting held December 14th, the organization was perfected by the election of Professor Edward L. Greene as President and Mr. Charles Louis Pollard as Secretary. The Club is to hold monthly sessions, devoting itself chiefly to systematic and ecological work, the field of physiology and vegetable pathology being covered by the already existing Botanical Seminar. At the December meeting the following resolutions, commemorative of the late Gilbert H. Hicks were unanimously adopted and ordered printed in the leading botanical journals of the country.

"It is with extreme sorrow and heartfelt regret that we learn of the death of our friend and colleague, Mr. Gilbert H. Hicks. To all of us he was known intimately as an earnest co-worker in the field of science and a genial member of our social organizations. His energy, earnestness and conscientiousness in scientific work commanded our approval, and secured recognition for him in all scientific circles as an able investigator. He had already done much to advance knowledge in his chosen line of work, and we feel that the cause of science has lost greatly by his untimely death.

"Much of his work, though of a high scientific character, had been so directed as to yield results of the greatest practical value in the production of food crops, and was intended to lighten, in some degree, the burden of struggling humanity. As a botanist, his keen appreciation of practical problems and his extensive knowledge of plant life well fitted him for this work for the people, and not only science has lost by his death, but all tillers of the soil, those who plow, sow and reap, have lost a true friend and counsellor.

"Yet to us, his daily associates, the loss is greatest. We shall miss his cheery greetings, his companionship, his counsel. It is thus with feeling of deepest sorrow and regret that we have learned that he has been taken from us, while yet in the prime and vigor of early manhood. To his sorrowing family we desire to express our heartfelt sympathy and condolence. We realize how inexpressibly great the loss has been to them, and we mourn with them.

"*Resolved*, That a copy of the above resolutions be sent to the family of the deceased and to the principal botanical magazines in this country."

CHARLES LOUIS POLLARD,
Secretary Washington Botanical Club.

Index to recent Literature relating to American Botany.

Blanc, L., & Decrock, E. Distribution Géographique des Primulacées. Bull. Herb. Boissier, **6**: 681–696. *pl. 17, 18.* Au. 1898; 697–713. S. 1898.

Bohlin, K. Studier öfver några slägten af Alggruppen Confervales Borzi. Bihang. Svens. Vet.-Akad. Handl. **23**^{3}: 1–56. *pl. 1, 2.* 1897.

Bohlin, K. Die Algen der ersten Regnell'schen Expedition. I. Protococcoideen. Bihang. Svens. Vet.-Akad. Handl. **23**^{7}: 1–47. *pl. 1, 2.* 1897.

Britten, J. *Botrychium australe* Br. Jour. Bot. **36**: 491. D. 1898.

Burkill, I. H. Changes in the sex of Willows. Ann. Bot. **12**: 557, 558. D. 1898.

Christ, H. Filices Novae. Bull. Herb. Boissier, **6**: 835–837. O. 1898.

Polypodium Schnittspalmii from Andes among other old world species.

Christ, H. Fougères recueillies dans le bassin inférieure de l'Amazone par le Dr. J. Huber à Para. Bull. Herb. Boissier, **6**: 991–994. 26 D. 1898.

New species in *Trichomanes* and *Polypodium.*

Clute, W. N. The Cleistogamous Flowers in the Genus *Viola.* Plant World, **2**: 47, 48. D. 1898.

Clute, W. N. Spring in the Shinnecock Hills. Plant World, **2**: 53–55. Ja. 1899.

Coville, F. V. The Fairy-ring Mushroom. Plant World, **2**: 39–41. *f. 1–3.* D. 1898.

Crepin, F. Observations sur le *Rosa stellata* Wooton. Bull. Herb. Boissier, **6**: 725–728. S. 1898.

Debski, B. Weitere Beobachtungen an *Chara fragilis* Desv. Jahrb. wiss. Bot. **32**: 635–670. *pl. 11, 12.* 1898.

De Candolle, C. Piperaceae Sodiroanae. Bull. Herb. Boissier, **6**: 475–495. Je. 1898; 505–521. Jl. 1898.

Many new species collected in Ecuador by Sodiro.

Dietel, P. Einige Brandpilze aus Südamerika. Hedwigia (Beiblatt) **37**: 147–149. 25 O. 1898.

New species in *Ustilago.*

Eastwood, A. Notes on the Flora of Marin County [California]. II. Erythea, **6**: 117, 118. 15 D. 1898.

Eaton, A. A. A new Species of *Botrychium*. Fern Bull. **7**: 7, 8. Ja. 1898.

B. tenebrosum sp. nov.

Eggleston, W. W. Some rare Vermont Ferns. Fern Bull. **7**: 4, 5. Ja. 1898.

Ellis, W. G. P. A Method of obtaining Material for illustrating Smut in Barley. Ann. Bot. **12**: 566, 567. D. 1898.

Errera, L. Structure of the Yeast-Cell. Ann. Bot. **12**: 567, 568. D. 1898.

Ganong, W. F. Contributions to a Knowledge of the Morphology and Ecology of the Cactaceae: II. The Comparative Morphology of the Embryos and Seedlings. Ann. Bot. **12**: 423–474. *pl. 26.* D. 1898.

Gilbert, B. D. *Dryopteris Noveboracensis* without Indusia. Fern Bull. **7**: 3. Ja. 1898.

Green, J. R. The Alcohol-producing Enzyme of Yeast. Ann. Bot. **12**: 491–497. D. 1898.

Greene, E. L. Wisconsin Field Notes. Plant World, **2**: 37, 38. D. 1898.

Grout, A. J. Some floral Monstrosities. Plant World, **2**: 64. Ja. 1899.

Hallier, H. Bausteine zu einer Monographie der Convolvulaceen. Bull. Herb. Boissier, **5**: 1021–1052. D. 1897; **6**: 714–724. S. 1898.

Halsted, B. D. Partial Sterility of fertile *Woodwardia* Fronds. Plant World, **2**: 55, 56. Ja. 1899.

Hartog, M. Alternation of Generations. Ann. Bot. **12**: 593, 594. D. 1898.

Huie, L. H. Changes in the Gland-Cells of *Drosera* produced by various Food-materials. Ann. Bot. **12**: 560, 561. D. 1898.

Ikeno, S. Untersuchungen über die Entwickelung der Geschlectorgane und den Vorgang der Befruchtung bei *Cycas revoluta*. Jahrb. wiss. Bot. **32**: 557–602. *pl. 8–10.* 1898.

Janczewski, E. de. Études morphologiques sur le genre *Anemone* L. Rev. Gen. Bot. **10**: 433–446. 15 N. 1898.

Jeffrey, E. C. The Gametophyte of *Botrychium Virginianum*. Trans. Canadian Inst. **5**: —(1–32). *pl. 1–3.* 1898.

Jones, C. E. The Anatomy of the Stem of Species of *Lycopodium*. Ann. Bot. **12**: 558, 559. D. 1898.

Juel, H. O. Die Ustilagineen und Uredineen der ersten Regnell'schen Expedition. Bihang. Svens. Vet.-Akad. Handl. **23**^{10}: 1–30. *pl. 1–4.* 1897.

Chaconia and *Leptinia* nov. gen. New species in *Puccinia*, *Aecidium* and *Uredo*.

Keller, R. Ueber die central- und südamerikanichen *Hyperica* des Herbarium Hauniense. Bull. Herb. Boissier, **6**: 253–268. S. 1898.

Klebs, G. Alternation of Generations in the Thallophytes. Ann. Bot. **12**: 570–583. D. 1898.

Lang, W. H. Alternation of Generations in the Archegoniatae. Ann. Bot. **12**: 583–592. D. 1898.

Lind, K. Ueber das Eindringen von Pilzen in Kalkgesteine und Knochen. Jahrb. wiss. Bot. **32**: 603–634. 1898.

Lloyd, J. U. *Laurus Sassafras.* Pharmaceutical Review, **16**: 450–459. D. 1898.

Macoun, J. M. Contributions to Canadian Botany, XII. Ottawa Nat. **12**: 161–172. D. 1898.

Malme, G. O. A: N. Die Flechten der ersten Regnell'schen Expedition. I. Die Gattung Pyxine. Bihang. Svens. Vet.-Akad. Handl. **23**^{13}: 1–52. 1897.

P. corallifera and *P. obscurascens* new.

Maxon, W. R. Young Hart's Tongues at Green Lake. Fern Bull. **7**: 1, 2. Ja. 1899.

Meehan, T., Editor. *Liatris odoratissima.* Meehan's Monthly, **8**: 177, 178. D. 1898.

Merriam, C. H. Life Zones and Crop Zones of the United States. Bull. U. S. Dept. Agric. (Biol. Survey) **10**: 1–73. 1898. [Illust.]

Moser, J., & Hay, G. U. List of Mosses of New Brunswick. Bull. Nat. Hist. Soc. N. B. **16**: 23–31. 1898.

Nathansohn, A. Beiträge zur Kenntniss des Wachsthums der trachealen Elemente. Jahrb. wiss. Bot. **32**: 671–686. *pl. 13.* 1898.

Orton, W. A. A partial List of the parasitic Fungi of Vermont. Ann. Rep. Vt. Agric. Exper. Station, **11**: — (1–21). S. 1898.

Otis, D. H. Root Tubercles and their Production by Inoculation. Industrialist, **24**: 363–378, *pl. 17.* Je. 1898.

Pammel, L. H. Old Lake Vegetation in Hamilton County, Iowa. Plant World, **2**: 42–45. D. 1898. [Illust.]

Plank, E. N. Concerning the Plants of Southwestern Arkansas. Plant World, **2**: 45–47. D. 1898.

Plumb, C. S. The geographic Distribution of Cereals in North America. Bull. U. S. Dept. Agric. (Biol. Survey) **11**: 1–22. *f. 3.* 1898.

Rothrock, J. T. Honey Locust. [*Gleditschia triacanthos* L.] Forest Leaves, **6**: 201. D. 1898.

Saunders, De A. Phycological Memoirs. Proc. Cal. Acad. Sci. Bot., III., **1**: 147–168. *pl. 12–32.* 31 O. 1898.

Contains descriptions of "Some Pacific Coast Ectocarpaceae" of the "Sphacelariaceae and Encoeliaceae of the Pacific Coast; new species, varieties and forms in *Ectocarpus*, *Pylaiella*, *Sphacelaria*, *Scytosiphon* and *Colpomenia*; *Halorhipis*, gen. nov.

Schrenk, H. von. On the Mode of Dissemination of *Usnea barbata.* Trans. Acad. Sci. St. Louis, **8**: 189–198. *pl. 16.* 17 D. 1898.

Schumann, K. Ueber *Opuntia tunicata* Lk. et Otto. Monatsschrift für Kakteenkunde, **8**: 154–156. 15 O. 1898.

Shaw, W. R. Ueber die Blepharoplasten bei *Onoclea* und *Marsilia.* Ber. deutsch. Bot. Ges. **16**: 177–184. *pl. 11.* 10 S. 1898.

Smith, E. F. Notes on Stewart's sweet-corn germ, *Pseudomonas Stewartii* n. sp. Proc. A. A. A. S. **47**: 422–426. D. 1898.

Smith, J. Donnell. Primitiae Florae Costaricensis. (Polypetalae.) **21**: 1–126. 1898.

Solereder, H. *Buddleia Geisseana* R. A. Philippi, eine neue *Lippia* Art. Bull. Herb. Boissier, **6**: 623–629. Jl. 1898.

Stephani, F. Die Lebermoose der ersten Regnell'schen Expedition nach Sudamerika. Bihang. Svens. Vet. Akad. Handl. **23**^{2}; 1–36. 1897.

New species in *Anthoceros*, *Fimbriaria*, *Frullania*, *Lejeunea*, *Nardia*, *Riccia* and *Ricciella.*

Stephani, F. Species Hepaticarum. Bull. Herb. Boissier, **6**: 757–799. O. 1898.

Completes Ricciaceae and describes lower forms of Marchantiaceae.

Stevens, W. C. The Behavior of Kinoplasm and Nucleolus in the Division of the Pollen Mother Cells of *Asclepias Cornuti.* Kan. Univ. Quart. **7**: 77–85. *pl. 5.* Ap. 1898.

Suksdorf, W. N. Washingtonische Pflanzen. Deutsche Bot. Monats. **16**: 209–212. N. 1898.

New species in *Delphinium*, *Nasturtium*, *Arabis* and *Silene.*

Svedelius, N. Die Juncaceen der ersten Regnell'schen Expedition. Bihang. Svens. Vet.-Akad. Handl. **23**^{6}: 1–11. *pl.* 1897.

Tilden, J. E. The Study of the Algae. Plant World, **1**: 148–150. *f. 1–3.* Jl. 1898.

Tilden, J. E. The Study of Algae in High Schools. Plant World, **2**: 59–63. Ja. 1899.

Tracy, S. M. A Report upon the Forage Plants and Forage Resources of the Gulf States. Bull. U. S. Dept. Agric. (Div. Agrost.) **15**: 1–55. *f. 1–20.* 1898.

True, R. H. Geographical Distribution of *Dicrana.* Fern Bull. **7**: 25–27. Ja. 1898.

True, R. H. Botanizing in the Dales of the Wisconsin River. Plant World, **1**: 81–83. Mr. 1898.

Urban, J. Plantae novae Americanae imprimis Glaziouanae. Bot. Jahrbuch. Beiblatt. **25**: 1–51. 19 Jl. 1898.

New species from Brazil in Rhamnaceae, Turneraceae, Umbelliferae, Buettneriaceae, Bombacaceae, Rutaceae, Asclepiadaceae and other families.

Wager, H. The Nucleus of the Yeast-Plant. Ann. Bot. **12**: 499–543. *pl. 29, 30.* D. 1898.

Ward, H. M. A Potato-Disease. Ann. Bot. **12**: 561–564. D. 1898.

Ward, H. M. *Penicillium* as wood-destroying Fungus. Ann. Bot. **12**: 565, 566. D. 1898.

Ward, L. F. A New Compass Plant. Plant World, **1**: 118. My. 1898.

Waters, C. E. Witches' Broom on the Locust. Plant World, **1**: 83, 84. Mr. 1898.

West, W., and G. S. Notes on Freshwater Algae. Journ. Bot. **36**: 330–338. S. 1898.

Tetraedon Floridense sp. nov., from Deland, Florida

White, C. A. Protective Stipules. Plant World, **1**: 106–108. Ap. 1898.

White, C. A. Tuna and its Distribution. Plant World, **1**: 166–168. Au. 1898.

Wieler, A. Die Function der Pneumathoden und des Aërenchyms. Jahrb. wiss. Bot. **32**: 501–524. *pl. 7.* 1898.

Williams, F. N. Énumération provisoire des espèces du genre *Cerastium.* Bull. Herb. Bossier, **6**: 893–904. N. 1898.

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TORREY BOTANICAL CLUB

MARCH 1899

On the Development of the Pollen Grain and the Embryo-sac in Bignonia venusta

BY B. M. DUGGAR

(PLATES 352–354)

SPORANGIAL AND ARCHESPORIAL DEVELOPMENT

The microsporic Archesporium and Sporangium

Before the flower bud opens, median transverse and longitudinal sections of an anther of *Bignonia venusta* show the pollen mother-cells occupying four boat-shaped layers, as seen in cross section in Fig. 3. Each layer is a single cell in depth, and the general form of the archesporial areas somewhat closely resembles that characteristic of Solanaceae, Labiatae, etc., as described by Warming,* and as figured by him for *Datura Stramonium* and *Mentha aquatica.*

In *Bignonia* I have studied the archesporium and its investments in some detail, beginning with the archesporial and wall layer fundament. In Fig. 1, a cross-section of an anther from a bud of 1 to 2 mm. in diameter, it will be seen that the outer layer of periblem in two considerable regions on each side of a radial line is somewhat richer in protoplasmic contents, and it would seem to be already slightly differentiated as a fundament. General placental growth is now largely confined to the regions x, x. Placental growth, however, soon becomes more marked at y, y, and so continues until the general form is that of Fig. 2. Even

---

*Warming, E. Untersuchungen über Pollenbildende Phyllome und Kaulome. Bot. Abhandl. Hanstein, **2**: 1–90. 1873.

[Issued 18 March, 1899]

before the latter stage has resulted, the outer layer of periblem in general has become well differentiated, some of the hypodermal cells in the region *m, m* have already lost their previous slight differential character (or lose it entirely with further development), and the four regions of Fig. 2 are evident, but not sharply defined. Thus it would seem difficult here to locate the sporangia relative to the surface of the sporophyll on which borne, unless beginning with such a stage as Fig. 2, where the connective, *m*, is already distinctly different from the remaining portions of the hypodermal layer, and might be taken as separating an upper from a lower surface. Engler's * studies on many forms led to the conclusion that in both extrorse and introrse anthers two sporangia are borne on each surface. My observations on *Bignonia* suggested at an earlier stage a common fundament for each pair of sporangia in radial arrangement, and the improbability of any distinction between upper and lower surfaces in the young condition. Moreover, from what we know of stamens which have been partially changed from staminal to purely floral organs, as in *Canna* and in the pond lily, there is no such location of sporangia, it would seem.

The cells of the hypodermal layer at *x, x* and *y, y*, Fig. 1, divide by periclinal walls into two layers, as in Fig. 5. The inner of these layers rapidly becomes rich in protoplasm, the nucleus increases in size and the cell wall in thickness, and there results the primitive archesporium of about six or eight cells in each sporangial region, in cross section. In the primitive archesporium the cells undergo no further periclinal divisions, and a single layer is maintained until maturity; but at a later period, when the cells have increased in size and peculiarity, a few radial divisions occur, as in Figs. 6 and 10, usually increasing the extent of the layer to about thirteen cells at the middle part.

In the meantime the cells of the wall layer (secondary hypodermal) divide, forming on the inside a layer of cells soon differentiated as the outer tapetum, and on the outside the first true wall layer, Figs. 5 and 6. The next periclinal division throughout the wall layer, Fig. 7, completes the general development on the outer side. However, around the ends of the boat-shaped archesporial masses, there is some irregularity. The cells equivalent to the general tapetum, as well as those of the outlying wall layer, usually divide several times, Fig. 8, so that the terminal portions of the archesporial layer are sunk deeper into the general tissue.

---

* Engler, A., Beiträge zur Kenntniss der Antherenbildung der Metaspermen. Jahrb. wiss. Bot. **10**: 275–316. 1876. Compare IV., "Uber die sogenannten introrsen und extrorsen Antheren, pp. 299–305."

The layer of cells on the inner surface of the archesporium gradually differentiates itself into an inner tapetum, and here also there are no further tangential divisions.

The two general wall layers persist, and there is no fibrillar development of the outer wall layer. At the time of dehiscence of the anther, these layers are compressed, and the epidermis somewhat modified. According to the early work of Purkinge,* Mirbel† and others the endothecium of these writers (final wall layer) is always partially or wholly fibrous. The more extended study by Chatin ‡ upon developing, mature and dehiscing anthers in a large number of orders demonstrated that this generalization could not be made. Moreover, he found that the presence of fibrous structures is not at all dependent upon the natural position of the order. Chatin distinguished three general classes in which no fibrous layer occurred, as follows :

"1. Que les cellules fibreuses manquent, en général, dans les anthères á déhiscence poricide.

"2. Que les cellules fibreuses sont défaut dans un certain nombre d'anthères á déhiscense longitudinale.

"3. Que dans quelques plantes dont les étames paraissent avoir subi un arrêt de développement, sinon morphologique du moins histologique, l' absence de cellules fibreuses coincide avec la mauvaise conformation du pollen."

Thus he found that among dicotyledons the fibrous tissue is entirely absent in Melastomaceae, Vacciniaceae, and Ericaceae. Again, it is absent in members of such widely separated orders as Tremandraceae (*Tetratheca*), Caesalpinaceae (*Cassia*), Ebenaceae

---

* Purkinge, J. E. De cellulis antherarum fibrosis, Vratislaviae. 1830. [Ref. Chatin ‡.]

† Mirbel, Complément des observations sur le *Marchantia*, suivi de recherches sur la métamorphose des utricles et sur l'origine, les développements et la structure de l'anthère et du pollen dans les végétaux Phanérogames. Mém. de l'Acad. royale des Sci. **13** : ——. 1835.

‡ Chatin, A. De l'Anthère, Paris. 1870.

(*Diospyros*), Myrsinaceae (*Badula*), Solanaceae (*Lycopersicum*), Acanthaceae (*Thunbergia*), Asclepiadaceae (*Gonolobus*), and Compositae (*Chaetophora*). It is evident that he noted the absence of such fibrous tissue in *Bignonia*, for he briefly refers to the large cells of the epidermis (see Fig. 11) as doubtless aiding in the dehiscence of the anther, these cells increasing in size very rapidly when the pollen approaches naturity.

During the growth of the archesporium, the tapetal cells may divide radially; but they soon become considerably modified in appearance, and only nuclear divisions occur. The process of nuclear activity in the tapetum are much as Strasburger* has described. The nuclei divide karyokinetically, Fig. 9, but no cell plate is formed. In time the daughter nuclei may move together, touch, and become flattened against each other, thus appearing as if in the process of direct division. In *Bignonia*, however, the nuclei often remain apart throughout.

It is of some interest to note the rate of growth in the cells of the archesporium, beginning even with the outer periblem layer which gives rise to the archesporium by its first periclinal divisions, measuring the time by the development of the archesporial investments, etc.

The following table indicates the measurements:

TIME.	ARCHESPORIAL.		
	Cell.	Nucleus.	Nucleolus.
Periblem layer first differentiated........................	9.5–13×11–13 μ	5.57 μ	2.8 μ
After the outer tapetum is cut off........................	11–15×16.5–19 μ	8–9.6 μ	4–4.8 μ
Immediately after the final division of the wall layer.	16.5–19×22–27.5 μ	11–14 μ	5.5 μ
During synapsis of the definitive archesporial cells..	30–44×44–60 μ	16.5–18×16.5–22 μ	6.9 μ

After synapsis there is little growth in the pollen mother-cells until divisions begin, although during the spirem stage the nucleolus often attains a general diameter of 8 μ, and a long diameter even greater.

Nucellus and Integument

The ovule development conforms quite closely to that characteristic of most Gamopetalae. The protuberance arising from the placental tissue is a small mass of parenchymatous cells, and in this mass of tissue, growth is much more rapid on one side than on the other, consequently giving the anatropous ovule. In the nucellar mass a large hypodermal cell is soon differentiated as the primitive archesporium. It is readily distinguished by its greater size and by the richness of its protoplasm, see Fig. 12. As this archesporial cell elongates apically, it is enveloped in the epidermal layer alone, and there is no further nucellar development. The funiculus is considerably enlarged, and the cells beneath the archesporial cells are considerably elongated, as in Fig. 13. The single thick integument develops from below these elongated basal cells. During the subsequent expansion of the archesporium into four cells, the nucellar cells are greatly compressed and stretched, as in Fig. 16. Finally, the growth of the embryo-sac causes the complete disorganization of these apical nucellar cells, which disintegrate as the embryo-sac pushes itself out to such an extent as to encroach upon the cells of the integument. Meanwhile, the cells at the base of the embryo-sac become thick-walled and further elongated.

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* Strasburger, E. Theilungsvorgänge der Zellkerne, 99–100. 1882.

Macrosporic Archesporium

In the microsporangia, both of the divisions of the pollen mother-cells are complete before there is any differentiation in the macrosporangium of the primitive archesporium, or initial cell. When first recognizable as the primitive archesporium, this hypodermal cell is about 15 μ in length. No tapetum is cut off, and growth is rapid. At the time of synapsis in the nucleus of this archesporial cell, the latter is 45 μ in length, and its size, when the spindle begins to form, is about 60 μ. The cell is rich in protoplasm, sometimes with a single vacuole in the vicinity of the nucleus. Owing to the narrow transverse diameter of the cell, the nucleus is often oblong in form. During the formation of the first spindle, the transverse diameter of the cell increases appreciably, Fig. 39. The two equivalent cells resulting from the first division rapidly divide again, usually synchronously in all details, Fig. 15, and there result the four highly differentiated and equivalent cells regarded as potential macrospores, as in Fig. 16. As a rule, the fourth cell of this axial row immediately begins to enlarge at the expense of the others, as shown in Fig. 17. I have noticed several instances in which the third cell retained its normal appearance later than the first two; but ultimately the fourth cell develops the embryo-sac.

In having a single axial row of four cells, and in possessing no tapetum, *Bignonia* agrees with such monocotyledons as *Sisyrinchium iridifolium* and *Hemerocallis fulva* (usually), according to Strasburger *; and among gamopetalous dicotyledons, so far as I have found from literature accessible, with all that have been studied, namely, with Compositae * and Labiatae *; also with some Ranunculaceae † and Berberidaceae.‡

Embryo-sac

The embryo-sac develops by the immediate growth of the fourth or lowest macrospore in the axial row, as mentioned. Since reduction has already taken place, its nuclear divisions are of less interest. The embryo-sac is late in developing, and it is not mature when the flower is fully open. As a rule, it seems to become unhealthy in this conservatory material after the first or second division. The nuclei are small, and divide rapidly. Generally, the embryo-sac became disorganized so readily, and latest ages were so difficult to secure, that lack of effective pollination was suggested as a possible cause of the difficulty. Artificial pollination with pollen from the same plant was ineffective, and attempts were futile to secure in good condition pollen from other plants in distant greenhouses. Embryo-sacs with two and with four nuclei were more commonly seen, as in Fig. 18; but only in a single instance was a mature embryo-sac found, and this was perfectly normal, with the characteristic eight nuclei, as shown in Fig. 19. The three antipodals are free, with no indications of disintegration, the polar nuclei are beginning to fuse, and the sexual nucleus has taken up its position immediately below the two synergids.

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* Strasburger, E. Angiospermem und Gymnospermen.

† *a.* Mann, L. E. The Embryo-sac of *Myosurus minimus.* Trans. and Proc. of Bot. Soc. Edinburgh, **29**: 351. 1892. *b.* Mottier, D. M. Contributions to the Embrology of the Ranunculaceae. Bot. Gaz. **20**: 241, 296. 1895.

‡ Andrews, F. M. Development of the Embryo-sac of *Jeffersonia diphylla.* Bot. Gaz. **20**: 423. 1895.

DEVELOPMENT OF THE POLLEN GRAIN AND OF THE DEFINITIVE ARCHESPORIUM.

Development of the Pollen Grain

Very early in the development of the microsporangium the definitive archesporium is differentiated, and the nuclei of the pollen mother-cells enter upon a considerable period of rest and growth. As previously mentioned, the few divisions which have occurred in the primitive archesporium are truly of the vegetative or homotypic character, and very little of interest is connected with them. The chromosomes are then small, oval or oblong, and number about fifty, the full number of the sporophyte generation.

The Resting archesporial Cell and its Nucleus

In general, from the time of the last divisions in the primitive archesporium until synapsis of the definitive cells, the pollen mother-cells increase in size to at least twice their former diameter, the nucleus is about two-thirds larger, and the nucleolus approximately one-half greater in diameter. The nucleolus, however, is now larger than the original nucleus of the early differentiated periblem layer.

In the resting cell the cytoplasm is closely netted and the nuclear membrane distinct. The nucleolus takes the gentian stain in the Flemming combination. It is a striking feature in these nuclei that there is very little chromatin on the reticulum, and the nucleolus takes the chromatin stain constantly. In the early period of growth the nucleolus shows a deeper-strained outer zone. This is more evident in the early stages, but before the time of synapsis it is no longer noticeable. Small clear spaces in the nucleolus, which have been termed vacuoles, are present. I have generally been able to trace to these spaces linin strands of the nucleolus, as in some other plants studied later ; and it seems highly probable that the appearance of small vacuolations are often only projections on the surface. This occurs not only during the reticulum stage, but also later.

The reticulum is more closely interlaced in the periphery of the nucleolus, and upon it are found slight thickenings and granules which give up their gentian readily. In addition, there are found a few spherical chromatic masses at definite points on the linin, staining deeply with the gentian.

Under the lower powers the cytoplasm has a granular appearance, and under very high magnification it is very closely netted. In *Bignonia* the cytoplasm is very dense, and as a consequence kinoplasmic radiations or fibers are not so readily distinguished, and probably some effects, especially in later stages of division, are thus obscured.

Synapsis

On passing into the condition of synapsis, Fig. 20, the linin framework is somewhat thicker than in the resting condition. I have observed no double row of chromatic granules nor any indication of fission previous to the contraction of the thread. As usual, during synapsis the contracted linin mass stains poorly, taking the orange diffusely. The coils of the contracted mass are not entirely obscured by the density of the ball, but the diffuse staining renders problematical any full account of changes that may occur during this period.

The nucleolus is at one edge of the contracted thread, and from the optical periphery there are one or more projections on its surface. Several so-called vacuoles may be seen in the middle part, but these also often represent projections, sometimes swollen, leading to linin attachments. Sometimes these structures are refractive. In this stage the nucleolus of the tapetal cells shows some signs of disintegration, and upon its surface there appear very large and refractive clear spaces. These undoubtedly enclose air in some way, and by long treatment with xylol and alcohol, as suggested by Zimmermann,* or even with treatment by xylol alone, these vacuoles largely disappear. They disappear at least so far as the air present is concerned, but certain clear spaces remain as before, showing no special refractive power.

The Spirem Stage and Segmentation

No indication of a true spirem is seen until after synapsis, and the initiation of this spirem is marked by a stronger reaction to the stains. At first the spirem consists of a loose, slightly thickened

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* Zimmermann, A. Morphologie und Physiologie des Zellkernes, 41.

thread with many small granules, and a few larger ones. At this stage I have found no indication of distinct rows of granules. They are evidently rapidly formed, however, for somewhat later there is a general splitting of the ribbon with its numerous granules (as in Fig. 21), the parts cf which may be adjacent for some distance, and separating widely in other places. The divided thread becomes greatly looped and twisted, apparently making definite bends upon itself in certain regions, but there does not seem to be segmentation in the sense that the entire ribbon falls into distinct segments, the whole extent of each segment entering into a single chromosome (see Fig. 22). Nevertheless, each bent or loop-like portion resulting is undoubtedly the basis of a chromosome, and in a certain view the loop formation is very evident. The figures indicate that we may have a process closely parallel to what is described in the Hepaticae.* The resulting chromosomes often appear spherical, with a few projecting edges. They may seem to be made up of two or three chromatic masses closely fused; and again, or from another view, there is an evident concavity on one surface (Fig. 23).

Throughout this period, also, minute linin attachments connect the chromosomes and the nucleolus, and the nucleolus is often drawn out into a fusiform condition. Some abnormal nuclei occur in which the nucleolus is actually drawn out into the form of a ribbon.

In several anthers I have found two nuclei in many pollen mother-cells during the spirem stage. They are usually abnormal in form, but there has been no indication of how the division has been effected.

The First Division

On the disappearance of the nuclear membrane the kinoplasm of which it is composed opens into the nuclear hollow, the kinoplasmic threads of the membrane being apparently the first to be attached to the chromosomes. Soon, however, the kinoplasm enters from all directions, and it is drawn into the form of a truly multipolar spindle, as often described (see Fig. 24). The general axis of the spindle is finally determined; so that it becomes multipolar in one general plane, and then by a gradual contraction process it becomes bipolar.

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* Farmer, J. B. On Spore-Formation and Nuclear Division in the Hepaticae. Ann. Bot. 9: 469–523. 1895.

The chromosomes seem to increase in size just before the disappearance of the nuclear membrane. On this entrance of the kinoplasmic fibers there is no indication of the nucleolus, and I have no evidence of the manner of its disappearance.

During the later stages of spindle formation the chromosomes seem to change their form, possibly the splitting having already begun. When they are finally brought into an equatorial region, the alignment is not perfect (Figs. 25, 26), and the chromosomes are much scattered. This is characteristic of all first divisions in the production of the reduced number of chromosomes. The dense cytoplasm is apparently repelled from the spindle region, and only the poles of the completed spindle reach into the denser zone (see Fig. 25), thus somewhat resembling the condition found in *Hemerocallis fulva.** In *Bignonia,* however, the spindle fibers are very numerous, and they terminate in a more distinct apex. The spindle is very large for the total chromatin mass concerned. In this plant the nuclei are much larger than in others under study at the same time, but the chromosomes are much smaller.

Details of reduction phenomena were not followed, since the plants were not suitable for this purpose, but some especially interesting nucleolar phenomena were observed.

After the separation into the daughter segments the chromosomes show a very slight indication of a V-form, by short projections pointing towards the equator, as in Fig. 27. They pass to the poles in scattered and unaligned array, so that at this stage it is relatively an easy matter to estimate the number of chromosomes. From several counts I have concluded that there are twenty five, although twenty four and twenty six have been counted. In the very thin sections necessary for the study of these divisions the knife usually passes through some of the chromosomes, and from this results the only difficulty in counting them accurately.

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* Juel, H. O. Die Kerntheilung in den Pollenmutterzellen von *Hemerocallis fulva* und die bei denselben auftretenden Unregelmässigkeiten. Jahrb. wiss. Bot. **30**: 205–226. 1897.

After the daughter nuclei are formed the dense cytoplasm rapidly fills the original nuclear hollow, and a very delicate spindle remains. In the dispirem of the daughter nuclei the chromosomes become very irregular in outline, and gradually diminish in size, while there is being gradually formed a large nucleolar-like body with irregular outlines (see Fig. 28). This body takes the chromatic dyes, as did the nucleolus generally before. Afterwards, it seems that this body resulting from the fusion of the chromatic masses is hardly fully differentiated as a nucleolus before the chromatin is again rapidly deposited upon the linin, and the chromosomes are again differentiated for the second division. Here there is evidence of an interesting connection between the chromatin content and the nucleolus.

The Second Division

With the disappearance of the nuclear membrane, the chromosomes prepared for the second division are short and irregularly oblong, broader from one side view than from the other, apparently, and along the middle line of the broader side there is indication of a fission. I have not observed all stages in the formation of the second spindle, but in general it seems to be the same as in the case of the first spindle, except that the second is much more rapidly formed. The second spindle is much narrower than the first, and it is composed of relatively few bundles of fibers, rather than of the loose network of the first division (see Fig. 26). The fibers are more in the form of compact bundles, however, than in the first division (see Fig. 29). In this division there is also a fairly distinct nuclear hollow remaining. Arranged on the nuclear plate, the chromosomes have their long diameter in the plane of the equator, and separation is along the line of fission previously indicated, so that the resulting daughter segments are small and oval in axial view, and somewhat bacilloidal in polar view. Contrary to the condition in the anaphase of the first spindle, these daughter chromosomes move to the poles in a definite line, as in Fig. 30. The remaining central spindle is also composed of a small number of delicate fibers, and the spindle space is rapidly occupied by dense cytoplasm. With the formation of the nuclear membrane, a few polar radiations are evident, and the whole cytoplasm shows the effect of a general radial arrangement, from which there is soon differentiated the complex spindle characteristic of dicotyledons (Fig. 31).

In the daughter nuclei it is again evident that the chromosomes first become irregular and slightly fused, as in Fig. 31, and gradually the fusion continues, or by some process it is returned to one or to several chromatic masses. Where there are several large masses first formed, the fusion of these into a single mass is not always evident; but eventually one prominent nucleolus results, as in Fig. 32, thus agreeing with the condition found in the first division. This gradual mergence of the chromatin mass into characteristic forms has been carefully followed, and various stages in the return of the chromatin from the chromosome state to that of the large nuclear masses are shown in Fig. 33. This mass is at first irregular in outline, but in time this irregularity is lost. One or more linin attachments persist, and everything indicates that the nucleolus of the microspore nucleus has thus resulted from the direct or indirect fusion of chromatic material used in division.

The Microspore

The forming microspores become invested with walls of their own, even the cell plates of previous divisions disintegrating with the general wall of the mother-cell. When first set free, the microspore is somewhat elliptical in form, the nucleus small, and the nucleolus relatively large. It remains in the resting condition for some time, and undergoes a period of growth, during which time the tapetal cells disintegrate rapidly. Until the divisions in the pollen mother-cells are begun the tapetal cells have undergone no disintegration, although becoming granular in appearance and staining deeply. The mature microspore is invested with a very thick wall, and owing to lack of stages and some difficulties with fixing, I have not been able to study the division of the microspore nucleus. As a result of this division, however, the pollen grain contains a larger vegetative nucleus, and a smaller more chromatic generative nucleus. The latter is not separated in a daughter-cell by a permanent cell wall, for in the mature pollen grain it is a free nucleus. Division of the generative nucleus does not take place previous to germination.

DIVISIONS IN THE FORMATIONS OF THE AXIAL ROW OF THE NUCELLUS

Bignonia has not proved a very favorable subject for the study of the axial row divisions in the ovule. Besides being very small, the ovules are not readily separated from the placental attachments, and it is almost necessary to section the entire ovary. Moreover, the developing ovules are bent, and it is difficult properly to orient them so as to have the archesporial axis in a desired plane. Innumerable sections have afforded me only some of the salient stages, sufficient, however, to demonstrate the general method of the reduction divisions. It was very manifest that the reduction divisions did not take place in the embryo-sac, owing to the absence of the characteristic prophase appearance in its nucleus. Moreover, since all of the gamopetalous dicotyledons yet worked upon have no tapetum and only an axial row of four cells developed from the archesporial cell,* in any of these plants where such uniformity seems to exist it seemed of interest to study the divisions in the formation of the axial row. Details of the general macrosporic development have already been given, and here only division phenomena will be briefly discussed.

The resting nucleus of the initial cell is at first much like that of the underlying growing cells of the nucellus. The nucleolus is then relatively small and readily loses the gentian stain for the orange. There is a loose reticulum of linin threads, and upon this a considerable number of large granules taking the chromatin stain

As in the nuclei of the pollen mother-cells, synapsis is manifest at an early prophase stage. It is marked by the usual contraction of the linin ribbon, which is always in contact with the nucleolus on one side. The whole mass is usually in the center of the oval nucleus, the nucleolus in this case being in contact with the nuclear membrane, as in Fig. 34.

The archesporial cell has attained considerable length when the nucleus enters upon the spirem stage. The return from the condition of synapsis is especially marked by much better staining in the general ribbon. The ribbon is somewhat thicker than before, and the few large chromatic granules are replaced by a more chromatic ribbon, and by many more very evident granules, giving to the ribbon a nodulate appearance, as in Fig. 35. Moreover, the ribbon is coiled and looped in definite curves; and it may be readily seen that there are no anastomoses of the general thread.

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* Strasburger, Angiospermen und Gymnospermen.

The process of chromosome formation seems to follow the general method outlined for the first division of the pollen mother-cell, except that here no such definite loops or rings have been observed. Radiating from the nuclear membrane in the direction of the axis, especially, are kinoplasmic threads. The disappearance of the nuclear membrane initiates the formation of a loose spindle in every way equivalent to the one first formed in the pollen mother-cell. The chromosomes are again irregularly scattered in the region of the nuclear plate, and the characteristic heterotypic division of this plant is unmistakable (Fig. 38). In this case, however, there is no large space free from trophoplasm immediately surrounding the spindle. I have also been able to estimate the number of chromosomes in this division, and it corresponds to the reduced number of the male archesporium, about twenty five.

After the formation of the daughter nuclei, the chromosomes may be identified for a time (Fig. 39), but as no later telophase stages were found, I have no notes concerning the reappearance of the nucleolus, or the early stages in the formation of the second spindle. When the second spindle is complete (Fig. 40), a glistening cell wall separates the two daughter-cells, there is no indication of the former spindle fibers, and the cytoplasm is contracted or repelled from the newly-formed wall. The chromosomes are arranged at the nuclear plate in a definite plane, and the characteristic homotypic division is evident. They separate longitudinally, and the bacilloidal daughter segments pass to the poles on a definite alignment, as in the corresponding division in the microsporic development.

There is every reason to believe that these divisions are truly homologous with the two divisions in the pollen mother-cell, and that here we have the reducing divisions preceding the formation of the female sexual nucleus. Of the monocotyledons yet published upon, species of *Allium** show reduction, or the indication of reduction, in the division of the initial cells ; and among dicotyledons *Helleborus foetidus* and *Podophyllum peltatum*† show the reduced number of chromosomes during the formation of the axial row.

Notes on Material and on Methods

Material of *Bignonia venusta* in quantity was secured from the botanical conservatories. A single cluster of flower buds will give many stages of development ; but when it is desired to have material showing division in the pollen mother-cells, it is quite necessary to examine an anther from each bud in order to avoid loss of time in sectioning useless material. At first I experienced some difficulty in securing such stages from collections made during bright forenoons. On examining a number of buds it was easy roughly to locate the beginning of division by the bursting of the calyx lobes. By this means, during the early afternoon I located and marked about twenty buds apparently just preceding division. Half a dozen buds of the same stage were then examined as checks, and found to be just preceding the formation of the spindle. At ten o'clock the following morning the marked buds were examined and all of them had passed through both divisions of the pollen mother-cells. This one experiment, together with previous failures, led me to suspect that these divisions were very rapid in this plant, and probably occurred at night. Material collected at night did yield many divisions, but at noon on a cloudy day I likewise secured all material desired of these stages. Nevertheless, it may be of interest that these divisions were never found during bright days.

Fixing, embedding, etc. In general, the material studied was fixed in Flemming's solution, as this proves so generally satisfactory in work with plant tissues. The mixture is substantially Flemming's strong solution, and the formulae are given in percentages, and as made up for ½ gram osmic acid :

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* Strasburger, Ueber Kern und Zellteilung im Pflanzenreich, Histol. Beitr. H. I., 243.

† Mottier, D. M., Ueber das Verhalten der Kerne bei der Entwickelung des Embryosacks und die Vorgänge bei der Befruchtung. Jahrb. wiss. Bot. 31: 125–158. 1897.

16 c.c.	1%	Chromic acid	or	1 ⅓ grams
3 c.c.	2%	Osmic acid		½ grams
1 c.c.		Glacial acetic acid		8 ⅓ c.c.
		Water, about		160 c.c.

The Flemming triple stain of safranin, gentian violet, and orange was used to some extent. After much experimentation, however, it was found advisable to leave out the safranin. Gentian of the full strength recommended gave good results in chromosome differentiation; but the spindle structures were not then well stained. For spindle structures, and for the differentiation of the kinoplasm, best results were obtained by the use of a very weak gentian, in which the sections were stained from twelve to twenty-four hours.

Explanation of Plates.

PLATE 352.

All figures were drawn with the aid of an Abbè camera lucida, projection 30 cm., tube length 15.5 cm., Leitz oculars 3 and 8, and objectives 7 and $\frac{1}{16}$ (hom. imm.) were used.

FIG. 1. Cross section of young anther showing early differentiation of periblem layer, from which the archesporium and wall layers are eventually derived.

FIG. 2. The four sporangial regions well differentiated; later than Fig. 1.

FIG. 3. Outline of mature anthers in cross section.

FIG. 4. Division of the hypodermal layer forming primitive archesporium within.

FIGS. 5 and 6. Formation of the first true wall layer without, and the outer tapetum within.

FIG. 7. Development of the two wall layers.

FIG. 8. Extra growth around the ends of the archesporial regions.

FIG. 9. Nuclear division in the tapetal cells.

FIG. 10. Increase in extent of the archesporial layer by anticlinal divisions of the vegetative type.

FIG. 11. Epidermis and wall layers at the maturity of the anthers.

FIG. 12. Differentiation of the hypodermal cell as the initial cell of the macrosporic archesporium.

FIG. 13. Growth of the archesporium and development of the integument.

FIG. 14. Archesporial cell immediately preceding the first division.

PLATE 353.

FIG. 15. Second division in the axial row.

FIG. 16. The four cells of the axial row.

FIG. 17. Development of the fourth cell in the axial row at the expense of the others.

FIG. 18. Developing embryo-sac with two small nuclei.

FIG. 19. Mature embryo-sac with synergids and egg-cell, fusing polar nuclei, and antipodals.

FIG. 20. Nucleus of the pollen mother-cell in synapsis.

FIG. 21. Longitudinal division of the spirem thread.

FIG. 22. An early stage in the differentiation of the chromosomes in the nucleus of the pollen mother-cell.

FIG. 23. Nucleus with mature chromosomes.

FIG. 24. Formation of the multipolar spindle.

FIG. 25. The complete spindle of the pollen mother-cell showing scattered chromosomes and nuclear hollow.

FIG. 26. An enlarged view of a spindle in the same stage as in the preceding figure.

FIG. 27. A characteristic spindle in the anaphase of division.

FIG. 28. A telophase of the first division in which the chromatic substance is largely fused into a nucleolar-like body.

PLATE 354.

FIG. 29. Compact second spindle of the pollen mother-cell.

FIG. 30. An anaphase stage of the second division.

FIG. 31. A telephase of division before the formation of a cell plate.

FIG. 32. An early stage in the differentiation of the microspores.

FIG. 33. Various appearances of the chromatin content in the dispirem of the second division, preceding the formation of a nucleolus.

FIG. 34. Synapsis in the nucleus of the axial-row mother-cell.

FIG. 35. A spirem stage in the nucleus of the axial-row mother-cell.

FIG. 36. A nucleus showing longitudinal division of the spirem thread.

FIG. 37. A nucleus with chromosomes well formed.

FIG. 38. The first division in the macrosporic archesporium.

FIG. 39. A telephase stage in the same division.

FIG. 40. Complete spindles of the second division in the macrosporic archesporium.

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Studies in the Leguminosae.—III

By Anna Murray Vail

I. NOTES ON THE GENUS DOLICHOLUS (RHYNCHOSIA) IN THE UNITED STATES

DOLICHOLUS Medik. Vorles. Chur. Phys. **2**: 354. 1787. [Bot. Beob. des Jahres 1783: 211. 1784.]

[Rhynchosia Lour. Fl. Cochin. 460. 1790.]

[Arcyphyllum Ell. Journ. Acad. Phila. **1**: 371. 1818.]

[Copisma E. Meyer, Com. Pl. Afric. Austr. 132. 1835–1837.]*

Key to the Species

Copisma.—Twining, usually prostrate and trailing, or rarely more erect, perennial herbs: leaves 3-foliolate, the lateral leaflets inequilateral: flowers in slender axillary racemes or few-flowered clusters: calyx marcescent, not at all foliaceous, somewhat bilabiate, deeply 4-cleft; teeth subulate, the middle one the longest: corolla exceeding the calyx-teeth.—E. Meyer.

Racemes very slender, many-flowered, exceeding the leaves; flowers and legumes reflexed. 1. *D. minimus.*

Racemes 2–6-flowered, as long as or shorter than the leaves. 2. *D. parvifolius.*

Flowers short-pedicelled, solitary, or several together in the axils of the leaves. 3. *D. Texensis.*

Racemes short-peduncled, 2–4-flowered; bracts persistent. 4. *D. Swartzii.*

Arcyphyllum.—Slender, upright or elongated perennial, often twining herbs: leaves simple or 3-foliolate; lateral leaflets inequilateral: flowers in short-peduncled, axillary, few-flowered or, crowded clusters, or rarely elongated racemes: calyx 4-parted nearly to the base, persistent, the foliaceous segments linear or oblong-lanceolate, acuminate, nearly equal, the upper ones 2-toothed: corolla not exceeding the calyx-teeth.—Ell. Journ. Acad. Phila. **1**: 371. 1818.

Prostrate or climbing perennial vines.
  Leaves unifoliolate or in *D. Michauxii* rarely the uppermost trifoliolate; racemes axillary.
    Leaves reniform, cordate at base. 5. *D. Americanus.*
    Leaves reniform, truncate at base. 6. *D. Michauxii.*

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* The monotypic genus *Pitcheria*, Nutt. Journ. Acad. Phila. **7**: 93. 1834, though difficult to distinguish from *Dolicholus* by any absolute characters, differs from it greatly in general appearance and habit.

Leaves trifoliolate.
Racemes very short-peduncled or sessile.
Stems prostrate; leaflets cinereous. 7. *D. cinereus.*
Stems generally climbing.
Leaflets thickish, entire, ovate-rhombic. 8. *D. tomentosus.*
Leaflets thin, the margin with a few, broad rounded undulations. *D. tomentosus undulatus.*
Racemes peduncled or the uppermost short-peduncled, becoming elongated.
Prostrate; leaflets apiculate, 2.5–3.5 cm. long. 9. *D. Torreyi.*
Climbing vines.
Leaflets obovate-orbicular, thin, rounded at the broad apex, narrowed at the subcordate base. 10. *D. Lewtoni.*
Leaflets ovate or ovate-rhombic, thick, velvety-pubescent; racemes commonly much elongated. 11. *D. latifolius.*
Erect perennial herbs.
Leaves unifoliolate, reniform. 12. *D. simplicifolius.*
Leaves trifoliolate or some of the basal ones simple.
Racemes terminal and axillary, never long-peduncled and elongated.
Stems simple, 1–2 dm. high. 13. *D. intermedius.*
Stems simple or branched.
Racemes numerous, short, axillary; leaflets thick, velvety-pubescent, acutish or obtuse. 14. *D. erectus.*
Racemes numerous, short, axillary; leaflets densely velutinous, acute. 15. *D. Drummondii.*
Racemes terminal or a few of them axillary, commonly much elongated. 16. *D. mollissimus.*

1. **Dolicholus minimus** (L.) Medik. Vorles. Chur. Phys. **2**: 354. 1787.

Dolichos minimus L. Sp. Pl. 726. 1753.

Glycine reflexa Nutt. Gen. **2**: 115. 1818.

Rhynchosia Caribaea Nutt. Am. Journ. Sci. **5**: 298. 1822. Not *Glycine Caribaea* Jacq. 1786.

Glycine Lamarkii H.B.K. Nov. Gen. **6**: 424. 1823.

Glycine punctata DC. Mém. Leg. 365. 1823.

Glycine littoralis Vahl.; DC. Prodr. **2**: 385. 1825.

Rhynchosia minima DC. Prodr. **2**: 385. 1825.

Rhynchosia Caribaea DC. Prodr. **2**: 386. 1823.

Rhynchosia ervoidea DC. Prodr. **2**: 386. 1825.

Phaseolus Caribaeus Eat. & Wright. 353. 1840.

* *Rhynchosia Mexicana* Hook. & Arn. Bot. Beech. Voy. 287. 1841.

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* The synonymy given here is only that which can be applied to the American plant.

In pine woods, South Carolina to Florida, Texas and southward to Brazil.

A common plant in tropical regions. Very variable. An exceedingly small-leaved and flowered form occurs on the Florida Keys.

Type in the Linnean Herbarium.

2. **Dolicholus parvifolius** (DC.)

Rhynchosia parvifolia DC. Mém. Leg. 367. 1823.

Florida; West Indies. Apparently not common.

3. **Dolicholus Texensis** (Torr. & Gr.)

Rhynchosia Texana Torr. & Gray, Fl. N. Am. **1**: 387. 1838.

In dry soil, Texas to Arizona and North Mexico. Also in South Brazil and Argentina.

Type in the Herbarium of Columbia University.

This species has been reduced to *Dolicholus Senna* (Gillies) Kuntze (*Rhynchosia Senna* Gill. H. & A. Bot. Misc. **3**: 199. 1844). I have kept them apart here as the latter species is not very well known and will probably need further study to determine its rightful position.* There are two or even three distinct forms, of which very luxuriant ones with elongated stems and lanceolate-oblong or even linear upper leaves are *Dolicholus Texensis* var. *angustifolius* (*Rhynchosia Texana* var. *angustifolia* † Engelm. Pl. Wright. **1**: 44. 1852).

In Contribution à la Flore du Paraguay, by M. Micheli (Mem. Soc. Phys. Geneva, **28**: 1883). *Rhynchosia Texana* is maintained as distinct from *R. Senna* and a new species is described as *R. diversifolia* which apparently is very closely related to the *Dolicholus Texensis* var. *angustifolius* of North America.

4. **Dolicholus Swartzii**

Rhynchosia Caribaea Chapm. 104, 1860. Not *Glycine Caribaea* Jacquin. 1786.

A slender, somewhat twining perennial or woody vine. Stems apparently branching at the base, slightly striate, pubescent, sparingly resinous-dotted: stipules 4 mm. long, linear-lanceolate, ciliate, reflexed, at length caducous: petioles 2–6 cm. long, slender, channelled, pubescent: leaves 3-foliolate; terminal petiolule 8–12 mm. long; terminal leaflets 4–5 or 6 cm. long, ovate, long-acuminate, 3–4 cm. wide, rather thin, soft pubescent on both surfaces, resinous-dotted beneath; lateral leaflets smaller, inequilaterally ovate, commonly though not always long-acuminate: racemes 1–2 cm. long or less, 2–3 (?)-flowered, the short peduncles very slender: pedicels filiform, 3–4 mm. long, puberulent: bracts very small, persisting: calyx 3 mm. long, resinous-dotted; teeth shorter than the tube: corolla yellow, much exceeding the calyx; vexillum obovate, 8 mm. long, minutely puberulent and dotted with elevated yellow resinous dots or glands on the outside: ovary resinous-dotted, pubescent or bearded along the apex: legume 2.5–3 cm. long, 5–7 mm. wide, falcate, acute at the apex, tapering to the petiole, dark brown and coriaceous, pubescent, resinous-dotted: mature seeds 5–6 mm. long, oblong-ovoid, bright red.

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* I am much indebted to Mr. J. Henry Burkill for valuable notes on some South American material of this species in the Herbarium of Kew Gardens.

† *Dolicholus angustifolius* Kuntze, Rev. Gen. Pl. **3**: 60. 1898.

South Florida; Cuba.

My attention was first called to this species two years ago by a fragment in the Chapman Collection in the Herbarium of Columbia University, which purported to be *Rhynchosia Caribaea* DC. It was also labelled "South Florida, Blodgett." Somewhat later in looking over a large bundle of miscellaneous leguminous and mostly unnamed material in the Torrey Collection, I found a good original specimen of Mr. Blodgett's from Key West, with the following note: "Climbing high on trees. Flowers yellow, all seasons. Damp places." I concluded that it was an unnamed species, but owing to the uncertainty attached to the identity of *Rhynchosia Caribaea* (*Glycine Caribaea* Jacquin, Icon. Rar. *t. 146*. 1786), I was unwilling to undertake the responsibility of giving it a new name. Since then I have had the opportunity of examining the Jacquin plate, with which our Florida plant does not seem to have anything in common, except the shape of the legume.

Besides these two specimens, I have seen the following: Rugel, no. 137, from Key West, February, 1846, ex-Herb. Shuttleworth in the Herbarium of the British Museum, where there are also two fragments labelled "Hispaniola, Dr. Swartz." In the Kew Herbarium there is a specimen of it from Wright's collecting in Cuba, no. 2323, inscribed as *Rhynchosia Caribaea* ex-Griesb. Catal. Pl.

Cubens. and another of the same extraction is in the Herbarium of the Missouri Botanic Garden.

A duplicate of Rugel's no. 137, an excellent complete specimen, is also to be found in the Herbarium of the Museum at Paris. The Rugel specimen in the British Museum Collection bears notes to the effect that the plant climbs on shrubs and that it is rare.

I have named the species in honor of Dr. Swartz, the eminent author of the Flora Indiae Occidentalis.

As regards the true *Rhynchosia Caribaea* there is so much misunderstanding that it would be difficult to venture an opinion in regard to its identity. In the Index Kewensis *R. Caribaea Auct. Plur. ex Benth. Mart. Fl. Bras 15 : part 1. 205* is referred to *R. minima*, some broader-leaved forms of which certainly do resemble the plate on which *R. Caribaea* was based. The next reference in the Index is to *R. Caribaea DC. Prodr. 2 : 384. Am. Bor. ; Ind. Occ. ; Afr. Trop. et austr.* and in the same work such species as *R. acuminatum* Eckl. R. Zeyl., *R. gibba* E. Meyer, *R. inflata* and *R. malacophylla* Boj. (Mauritius), *R. intermedia* Kotschy & Peyr. and others are referred to *R. Caribaea.* I have not been able to study most of these species very critically, but as regards *R. gibba*, judging from the large collection of that plant in the Herbarium of the British Museum and elsewhere, it seems very doubtful that it belongs to the American species.

The description of *R. Caribaea* DC. agrees well with Jacquin's plate, but the distribution of the species reads "*in ins. Caribaeis, ad ripam flum. Orinoci, ex* Kunth, Nov. Gen. Am. 6. '*125*' (425) et in Florida occidentali." This latter locality for the plant should refer to *R. reflexa* Nutt., then given as synonym, a species which is now rightfully reduced to *R. minima* (L.) DC., so that it is probable that the true *R. Caribaea* does not occur within the limits of the United States. Quite an extensive search in London and Paris for an authentic specimen of this species met with but scant success. In the Herbarium of the Museum of Paris there is a specimen which probably belongs to *R. Caribaea.* It has the following inscription: "*Rhynchosia Caribaea* Willd. Jacq. Ic. *t. 146.*" Pinned on the sheet after the fashion of the older herbaria is a small label with this note: "Phaseolus Madrepotanis pubescens, siliquis brevibus hirsutis horti nostri sesei [?] Ray. vol. 3, appendix.

Herbier de Vaillant." The writing on the label is supposed to be that of either Sherard or of Ray, and interlined and blurred so that a few of the words could only be guessed at. The "Herbier de Vaillant" contains many West Indian plants, among others specimens from the Antillian collection figured by Plumier,* and this specimen might have had some such provenance. In the Herbarium of the British Museum a specimen of Triana's collection in New Grenada also fairly well agrees with the Jacquin plate, as do also the specimens collected by Dr. Palmer, no. 269, from the State of Jalisco, Mexico, with, perhaps, the exception of the somewhat smaller leaves; but the latter specimens certainly are not *R. phaseoloides*, under which name they seem to have been distributed. Another plant, exactly matching Palmer's, was collected by Fred. Muller, no. 1768, in Mexico, in 1853. (Herb. Columbia Univ.) It has the very hirsute legume which is so marked a characteristic of the figure of *R. Caribaea.*

In Hemsley, Biologia Centr. Am. **1**: 310, the distribution of *R. Caribaea* is given as South Mexico, near Tantoyuca (Ervenberg, no. 35) and "common in the West Indies and the northern part of South America; also in Tropical and South Africa." I have not seen the Ervenberg specimen, nor have I seen any South African specimens of *R. gibba*, which satisfied me as being identical with the plant figured by Jacquin. It proves a most interesting species, and it is to be hoped that these very incomplete notes will call the attention of collectors to it and possibly bring about a better knowledge of it and of its geographical distribution.

5. **Dolicholus Americanus** (Miller)

Lathyrus Americana Miller, Gardn. Dict. no. 19. 1768.

Rhynchosia menispermoidea DC. Mém. Leg. 364. 1823.

Phaseolus menispermoidea Eat. & Wright, N. Am. Bot. 353. 1840.

Texas to South Mexico.

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* Plumier's Herbarium of West Indian plants is preserved in the Herbarium of the Jardin des Plantes at Paris, where it is easily accessible to students. It consists of ten folio volumes, the specimens glued on the pages and numbered. They are in various stages of preservation and are especially valuable as being the originals of the figures in the Fasciculi Plantarum Americanum and of many Linnean types as well as the "Herb. Surian" of De Candolle's Prodromus.

Type in the Herbarium of the British Museum. For the record of the identification of this species see the article on Houston's Central American Leguminosae by James Britten and E. G. Baker in Journal of Botany for June, 1897.

6. Dolicholus Michauxii

Rhynchosia Michauxii Vail, Bull. Torr. Bot. Club, **22**: 458. 1895.

Rhynchosia menispermoidea Chapm. Fl. 105. 1860. Not DC.

Dry pine barrens, Florida.

Type in the Herbarium of Columbia University.

7. Dolicholus cinereus (Nash)

Rhynchosia cinerea Nash, Bull. Torr. Bot. Club, **22**: 149. 1895.

High pine lands, Lake County and Pelican Key, Florida.

Type in the Herbarium of Columbia University.

8. Dolicholus tomentosus (L.)

Glycine tomentosa L. Sp. Pl. 754. 1753.

Glycine tomentosa volubilis Michx. Fl. Bor. Am. **2**: 63. 1803.

Glycine tomentosa Pursh, Fl. Am. Sept. 486. 1814. Excluding var.

Arcyphyllum difformis Ell. Journ. Acad. Philad. **1**: 371. 1818.

Rhynchosia difformis DC. Prodr. **2**: 384. 1825. ?

Rhynchosia tomentosa H. & Pl. Comp. Bot. Mag. **1**: 23. 1835. Excluding the specimens.

Rhynchosia volubilis Wood, Bot. & Fl. 96. 1873. Not *R. volubilis* Loureiro, 1793.

The Linnean description of the species includes "*Ononis caule volubile*" Gronov. 81 and "*Anonis phaseoloides scandens, floribus flavis sessilibus*" Dill. Elth. 30 *t. 26. f. 29*, where the illustration is a good one of the plant as it is known on our eastern seaboard. The Clayton plants referred to are represented by two specimens in the Herbarium of the British Museum, one of *Glycine tomentosa*, the plant as figured by Dillenius, and one of the erect, oblong-leaved species described by Walter in 1788 as *Trifolium erectum*.

A specimen of the twining *Glycine tomentosa* is also in the Linnean Herbarium.

In dry soil, Virginia to Florida, Mississippi and probably also in Texas.

Dolicholus tomentosus undulatus n. var.

Perennial. Stems slender, twining, angled and striate, minutely and retrorsely hirsute: petioles 2–4 cm. long, angled, hirsute: stipules ovate, 3–4 mm. long, ciliate, persisting: leaves 3-foliolate; terminal petiolules 8 mm. to 5 cm. long; terminal leaflets oval or orbicular-oval, 2–4 cm. long, wide, obtuse or subacute, thinnish, minutely pubescent on both surfaces, with a few broad undulations on the margins; lateral leaflets inequilaterally ovate, 2–4 cm. long: racemes subsessile, 1–4- or 5-flowered: calyx 8–9 mm. long, pubescent, ciliate, resinous-dotted; lobes oblong, lanceolate, acuminate, foliaceous: corolla orange-yellow? nearly as long as the calyx or barely exceeding it when expanded; vexillum minutely puberulent near the apex and ciliate: legume 1.5–1.8 cm. long, oblong, obliquely acute, 5–7 mm. wide, minutely pubescent, resinous-dotted and hirsute with longer scattered hairs especially on the sutures, 2-seeded: seeds nearly 4 mm. long, semi-orbicular, shining, grayish with lighter and also dark brown markings.

Thickets and fields near Jacksonville, Florida, Chapman, 1846. (Herb. Mo. Bot. Gard.); N. Am. Pl. Curtiss, no. 660, July; Curtiss, no. 4256, July 6, 1893. (Distribution from the U. S, Nat. Herb.); Second Distr. Pl. Southern States, Curtiss, no. 4903. July 6–17, 1894.

9. **Dolicholus Torreyi**

Rhynchosia Torreyi Vail, Bull. Torr. Bot. Club, **22**: 459. 1895.

Rhynchosia latifolia β Torr. & Gray, Fl. N. Am. **1**: 285. 1838. Not *R. latifolia* Nutt.

Sand hills, Texas, Dr. Leavenworth. Apparently not since collected.

Type in the Herbarium of Columbia University.

10. **Dolicholus Lewtoni**

Rhynchosia reticulata? Chapm. Fl. Ed. 3, 115. 1897. Not DC.

Soft pubescent and minutely resinous-dotted throughout. Stem prostrate, 3–5 dm. long or more, 4-angled, spreading or obscurely retrorse hirsute-pubescent, apparently not twining at the summit: stipules obliquely lanceolate, 6–8 mm. long: petioles rather distant, 4–6 cm. long, angled: terminal leaflets dilated or obovate-orbicular, 4–6 cm. long, 4–8 cm. wide, commonly broadest above the middle, broadly rounded and sometimes slightly retuse at the apex, narrowly subcordate at the base; lateral leaflets obliquely obovate-oblong; venation reticulated: upper racemes sessile, 2–4 cm. long, the other on peduncles 2–4 cm. long: bracts lanceolate, 3–4 mm. long, slender: calyx 9–10 mm. long; segments foliaceous, exceeding the glabrous yellow corolla. Legume not seen.

Dry sandy soil, Orange County, Florida, F. L. Lewton, July 7, 1894.

Allied to *D. Michauxii* Vail, from which it differs in the trifoliolate, abnormally large leaves, which are notably broadest above the middle and with narrow and less prominent subcordate bases. The calyx and corolla are also smaller than those of *D. Michauxii* and the racemes are longer.

Type in the Herbarium of Columbia University.

11. **Dolicholus latifolius** (Nutt.)

Rhynchosia latifolia Nutt.; Torr. & Gr. Fl. N. Am. **1**: 285. 1838.

Phaseolus latifolius Eat. & Wright, N. Am. Bot. 353. 1840.

In dry soil, Missouri to Texas and Louisiana.

Very variable. A low erect or sub-erect form with short or sub-sessile racemes has been collected in Texas by Lindheimer and in Missouri by B. F. Bush and may possibly be distinct.

12. **Dolicholus simplicifolius** (Walt.)

Trifolium simplicifolium Walt. Fl. Car. 184. 1788.

Glycine tomentosa var. *monophylla* Michx. Fl. Bor. Am. **2**: 63. 1803.

Glycine reniformis Pursh, Fl. Am. Sept. **2**: 486. 1814.

Glycine monophylla Nutt. Gen. **2**: 115. 1818.

Arcyphyllum simplicifolium Ell. Journ. Acad. Phila. **1**: 371. 1818.

Glycine simplicifolia Ell. Sk. **2**: 234. 1825. Not H. B. K.

Rhynchosia reniformis DC. Prodr. **2**: 384. 1825.

Rhynchosia tomentosa var. *monophylla* Torr. & Gray, **1**: 284. 1838.

Phaseolus reniformis Eat. & Wright, N. Am. Bot. 353. 1840.

Psoralea alnifolia Bert. Mem. Acad. Sci. Bolog. **2**: 274. 1849.

Rhynchosia simplicifolia Wood, Bot. & Fl. 96. 1873.

In dry soil, Virginia to Florida, west to Louisiana.

Type in the Herbarium of the British Museum.

13. **Dolicholus intermedius** (Torr. & Gr.)

Rhynchosia tomentosa β intermedia Torr. & Gray, Fl. N. Am. **1**: 285. 1838.

Psoralea alopecurina Bertol. Mem. Acad. Sci. Bolog. **2**: 275. *pl. 14. f. 2.* 1849.

Stems erect, simple or possibly with 1 or 2 branches, angled, soft pubescent-tomentose, especially on the angles, 1.2–3 dm. high; stipules obliquely lanceolate, 6–9 mm. long, striate, red-brown, persistent: petioles 2.5–5 cm. long, densely pubescent; basal leaves simple; blades nearly orbicular or rhombic-orbicular, obtuse or depressed; upper leaves or only the uppermost 3-foliolate; terminal leaflet 2.5–5 cm. long, oval to ovate-orbicular, obtuse, sparingly pubescent above, pubescent and rugosely veined beneath when old; lateral leaflets obliquely oval or oblong, 2–3 cm. long, mucronulate, some of them subcordate at base: racemes terminal and axillary, sessile or short-peduncled; bracts lanceolate-linear, 1 cm. long, red-brown, pubescent outside, glabrous within: calyx 8–9 mm. long; teeth slender, veined, pubescent, resinous-dotted: corolla yellow; vexillum glabrous, the teeth at the base much shorter than the claw: legume not seen.

Allied to *D. simplicifolius* from which it differs in the 3-foliolate upper leaves, and generally taller and larger habit.

Georgia to Florida and Alabama. May to June.

Type in the Herbarium of Columbia University.

14. **Dolicholus erectus** (Walt.)

Trifolium erectum Walt. Fl. Car. 184. 1788.

Glycine tomentosa var. *erecta* Michx. Fl. Bor. Am. **2**: 63. 1803.

Glycine erecta Nutt. Gen. **2**: 114. 1818. ?

Arcyphyllum erectum Ell. Journ. Acad. Phila. **1**: 372. 1818.

Rhynchosia erecta DC. Prodr. **2**: 384. 1825.

Glycine Caroliniana Spreng. Syst. **3**: 197. 1826.

In dry soil, Delaware to Florida, west to Tennessee and Louisiana. Very variable.

Type apparently lost.

An oblong-leaved, rather remarkable form of this species has been collected by Hall in Louisiana, in Salisbury, Maryland [Herb. Canby], and in Mississippi byW. L. McGee.

15. **Dolicholus Drummondii**

Rhynchosia tomentosa Hook. & Arn. Comp. Bot. Mag. **1**: 23. 1835. Not Linn.

Perennial, erect, densely velutinous-tomentose, 1.5–3 dm. high. Stems angled, a little undulate above: stipules lanceolate, acuminate, becoming reflexed, caducous; petioles 3–5 cm. long, angled and velutinous: leaves 3-foliolate; terminal leaflets oblong-lanceolate or a few of them oblong, 3–6 cm. long, 2–3 cm. wide, acute, densely velutinous tomentose on both surfaces, silvery above, the whole lower surface dotted with numerous orange-colored glands beneath the tomentum and the prominent veins reticulated beneath; lateral leaflets narrower, inequilateral, acute; racemes subsessile or very short peduncled: bracts 2.5 mm. long, linear-setaceous, caducous: calyx 6 mm. long, foliaceous, tomentulose and ciliate, resinous-dotted, the upper lobe 2-toothed to considerably below the middle: corolla included in the calyx, apparently a deep orange-yellow color; vexillum round-ovate, the auricles at the base rounded, minutely glandular-puberulent on the outer surfaces: legumes not seen.

Louisiana: Covington, Drummond, 1832; North Carolina: New Bern, Croom and Loomis, 1834.

Very close to *D. erectum* from which it differs in the acute leaflets, dense tomentum and somewhat smaller flowers.

Type specimens in the Herbarium of Columbia University.

16. **Dolicholus mollissimus** (Ell.)

Glycine mollissima Ell. Bot. **2**: 235. 1824.

Rhynchosia tomentosa var. ? *mollissima* Torr. & Gray, Fl. N. Am. **1**: 285. 1838.

Rhynchosia mollissima S. Wats. Biblio. Ind. **1**: 256. 1878.

Rhynchosia tomentosa var. *erecta* Chapm. Fl. 105. 1884. In part.

Stems erect, commonly simple, 3–6 dm. high, angled above, not flexuous, clothed with a close fine soft pubescence: stipules 6 mm. long, red-brown, lanceolate, acuminate; leaves rather remote, 5–9 cm. long; petioles 2.5–5 cm. long; leaflets oval or oval-oblong, acutish, 2.4–4.5 cm. long, 2–3.5 cm. wide, minutely apiculate, obscurely emarginate, clothed with a short pubescence, especially on the reticulated, resinous-dotted under surface; terminal leaflet the largest, the others not conspicuously inequilateral; racemes terminal, elongated, 6 cm.–1.8 dm. long, with often few, short racemes in the axils of the upper leaves: flowers scattered along the whole length of the often crowded rhachis: calyx 6–8 mm. long, pubescent, resinous-dotted, 4-parted about two-thirds to the base; teeth lanceolate: corolla yellow; vexillum glabrous, the spurs of the claw obtuse: legume oblong, 2 cm. long, 6 mm. wide, attenuated below, somewhat rounded on the ventral suture, with a short, acute, slightly curved acumination: seed nearly orbicular, 2.5 mm. broad, flattened: seeds ovoid, 4 mm. long, brown, mottled.

In pine barrens, Florida.

II. NOTE ON PAROSELA

The following species has been identified with *Parosela Arizonica:*

Parosela Lumholtzii (Rob. & Fern.)

Dalea Lumholtzii Rob. & Fern. Proc. Am. Acad. **30:** 115. 1894.
Parosela Arizonica Vail, Bull. Torr. Bot. Club, **24:** 14. 1897.

Vicinity of Tucson, Arizona; Las Pinitos, Sonora, Mexico.

COLUMBIA UNIVERSITY, March, 1899.

Notes on some new and little known Plants of the Alabama Flora

By Charles Mohr

Several forms of plums without flowers and mature fruit, but seemingly distinct, have been for years a source of perplexity. Later discoveries of several species undescribed before, made in other parts of the Southern States, render now the identification of these doubtful forms from this State possible.

PRUNUS INJUCUNDA Small, Bull. Torr. Bot. Club, **25**: 149. 1898.

A low unsightly shrub scarcely exceeding four feet in height, with short straggling branches and branchlets, was found on the sandstone cliffs, at the summit of the Alpine Mountains, Talladega County (near the signal station), alt. 1800 feet, in September, 1892. This shrub was recognized by Dr. Small to be identical with his *Prunus injucunda* from the mountains of northern Georgia.

PRUNUS HORTULANA Bailey, Gard. & For. **5**: 90. 1892.

A small tree about 15 feet, rarely more, in height, branching low, forming small thickets on the shell banks or shell heaps along the shores of the inlets of the sea in Mobile County (Westfowl River, Bayou Coden). Confounded by the writer with *Prunus maritima* until a specimen was submitted to Professor C. S. Sargent, who, declaring that it had nothing in common with the Seashore Plum, somewhat doubtfully referred the tree from the Alabama shore to Bailey's species.

The fruits received a few years ago were about the size of a small Chickasaw Plum, greenish, of a reddish blush and with a slight bloom, thus agreeing with the description of the fruit of *Prunus hortulana*. The fruit ripens in September.

Prunus maritima in Chapman's Flora S. States, Ed. 3, *Alabama, Buckley*, most probably belongs here.

Prunus Alabamensis sp. nov.

Tree below medium size, scarcely over 25 or 30 feet high, about 6 inches in diameter with a rough bark: leaves thick, broadly ovate, rounded or slightly narrowed at the base, short acuminate, obtuse or acutish at the apex, bluntly serrate with appressed glandular-tipped teeth, smooth and of a dull green color above, paler and finely pubescent on the lower surface with short simple or forked rusty hairs, which become longer and more dense along the midrib and principal veins, veinlets somewhat prominent: racemes elongated, 4 to 6 inches long, peduncled, strictly erect; the rachis and short pedicels like the calyx pubescent; petals small (judging from the withered petals clinging yet to the calyx in the specimens collected on Red Mountain, near Birmingham).

As observed on the few fruiting specimens collected on the Chehawhaw Mountain (Talladega Co.), altitude about 2400 feet, the racemes become more spreading, drupes reddish to black and of the size of the fruit of the black wild cherry.

Readily distinguished from the latter by the character of the leaves and of the inflorescence as described above.

Not infrequent on the rocky summits (siliceous rocks) of the higher ridges in the Coosa Basin, Talladega County, Alpine Mountains. Clay: Chehawhaw Mountain in fruit, August 7th. Jefferson: Red Mountain, ledges of siliceous red iron ore, just past flowering, May 10, 1898.

Physalis monticola sp. nov.

Perennial from a horizontal rootstock; 10–12 inches high. Stem slender, assurgent, like the branches, angled and roughish by reflexed hairs along the angles; branches erect, more or less flexuous, becoming more villous towards their extremity with flat jointed single hairs: leaves ovate to oblong ovate, tapering at both ends, oblique at the base and decurrent on the narrow winged petiole, repand or subentire: leaf blade 1½ to 2 inches long, ¾ to 1 inch wide, thin, sparsely strigose, more densely hairy along the midrib, and principal veins, roughish hairy below, ciliolate; petioles ½ to 1 inch long: peduncles slender, nodding: calyx densely hairy at the base and on the lanceolate lobes: corolla ¾ inch wide, pubescent, dingy yellow with a dark brown center; anthers pale yellow: fruiting calyx deeply sunk at the base, ovate oblong, closed by the acuminate lobes, about 1½ inches long and ¾ inch wide at the base, not prominently angled.

Resembles slightly smoother forms of *Physalis heterophylla*. De Kalb County on Lookout mountain near Mentone, borders of fields, woods and pastures. In flower May 30, 1892; fine fruiting specimens collected in the same locality September 10, 1898.

Flowering specimens in poor condition were submitted to Mr. Rydberg, who pronounced the plant to be most probably new, but which with the scanty material at the time at command he would not undertake to describe.

EUPATORIUM LEPTOPHYLLUM DC. Prod. **5**: 176. 1836

Confounded by our botanists with *Eupatorium capillifolium*, with which it grows abundantly in the low flats of the Coast plain in old fields, pasture grounds and openings of the forest.

Differs from the latter in the broader divisions of the linear, not filiform leaves, the stouter wide spreading branches and slightly larger flowering heads.

Apparently confined to the Coast plain; eastward to Georgia. (*Savannah. DC. loc. cit.*) .

Solidago pallescens sp. nov.

Stem erect, 2½ to 3 feet high, more or less sparsely branched about the middle, striate puberulent: radical leaves oblong lanceolate, attenuated at the base, with a slender petiole: lower cauline leaves oblong-ovate, contracted into a petiole-like base or sessile, obtuse mucronulate, 2½ to 3 inches long and 1 to 1½ inches wide, smooth, ciliolate, with several irregular sharp teeth above the middle; upper cauline and rameal leaves ovate to ovate-lanceolate, all with a prominent midrib, faintly veined, of a pale glaucous hue; upper leaves reduced at the flowering branches to spatulate bractlets: racemes slender, erect, spreading: flowering heads single or few in a cluster, crowded, small, scarcely over ⅛ inch long; involucral bracts rigid, obtuse, slightly pubescent on the margin: akenes faintly ribbed, strigose hairy.

Metamorphic hills. Auburn, Lee county, 800 to 1,000 feet altitude. Baker and Earle, October, 1897.

A distinctly marked species resembling *S. brachyphylla*, from which it is readily distinguished by the obtuse mucronulate leaves, nearly all sessile and pale glaucescent, but smaller flowers and faintly ribbed akenes.

GNAPHALIUM SPATHULATUM Lam. Encycl. **2**: 758. 1786

This winter annual strikes the observer in the field as clearly distinct from *Gnaphalium purpureum*, with which it has been confounded. Specimens submitted to Professor E. L. Greene were declared to be identical with the allied species from tropical America. *Gnaphalium spathulatum* differs at once from the former by the simple stem, erect from the base like the leaves, greenish throughout every stage of growth, both covered loosely with a floccose woolly tomentum; by the cauline leaves being all broadly spatulate like the radical leaves; and further, by the racemose inflorescence with the flowering heads in close clusters, on the lower part of the stem borne on axillary branchlets one inch and over in length, and sessile towards its extremity.

Common in the southern part of the State from the Coast to the Prairie region in cultivated and waste-places, waysides, etc., flowering from the early spring to the close of the season. Always found in the vicinity of dwellings, apparently a fully naturalized introduction from the neighboring tropics; frequent in Mexico and the West Indies; *Gnaphalium Americanum* Mill. Dict.? (Grisebach, Flor. Br. W. Ind.) seems to be the same species.

MOBILE, February 18, 1899.

New Plants from Wyoming.—VI

By Aven Nelson

Ruppia curvicarpa

Stems light green, 6 dm. or more in length, capillary and fragile at maturity: leaves variable in length, 3 cm. or more long: peduncles long; pedicels several in a cluster, capillary, fragile, from 3–6 cm. long: drupes black at maturity, oblong, 2 mm. in length, gibbous at base, hence appearing obliquely placed on the pedicel, increasing slightly in diameter upward to the abruptly bent beak which is tipped with a sharp acumination.

Very abundant in the "alkali" lakes that occur at intervals on the Laramie Plains. It is no doubt most nearly related to *R. maritima* L. from which its very characteristic fruits and long fragile pedicels seem to separate it. It differs also in its seasonal development as it does not appear to reach maturity until late in September.

Type specimen in Herb. University of Wyoming from Laramie Alkali Lakes, October 24, 1896.

Salicornia rubra

Annual with a strong taproot, erect, pyramidal in form, closely and divaricately branched from base to summit, the opposite branches regularly at right angles to the preceding pair and gradually shorter upward, the lower branches themselves similarly branched, rather stout, about 3 mm. in diameter when green, joints about as long as broad: scales short, approaching triangular, much wider than long, subacute: fruiting spikes 2–4 cm. long, very numerous, assuming a ruby red at maturity: middle flower higher than the lateral ones, reaching to the summit of the joint: the calyx broadly ovate, about 1.5 mm. long: utricle obscurely pubescent, oval, 1 mm. long.

This well-marked species is, perhaps, nearest to *S. herbacea* L. under which name it has in fact been distributed by me under no. 1162. Its very compact and stouter habit and short joints at once separate it from that species. It thrives best along the low banks of the "alkali" lakes of the plains. The soil in these situations is not simply impregnated with sodium chloride, but often thickly encrusted with other salts, principally sodium sulphate. On these white stretches this is often the only plant and as it reddens under the September sun these patches present a singularly beautiful appearance.

Type specimen in Herb. University of Wyoming, no. 5284, Laramie, September 6, 1898.

Arabis exilis

Biennial, possibly more enduring, 3–5 dm. high (including the raceme): taproot vertical or rarely curved at the summit: stems single, rarely 2 or more, mostly strict but occasionally branched above, minutely stellate-pubescent, glabrate upward: radical leaves small, crowded on the crown, oblong, acute at both ends, 8–14 mm. long, petioles mostly shorter than the blade; cauline somewhat crowded, the lower petioled, the upper sessile but not auriculate-clasping, minutely and closely stellate-pubescent as are the radical leaves, broadly linear or lanceolate, acute, 1–4 cm. long: raceme naked, glabrate, fully half the length of the plant, erect or the summit slightly nodding: sepals broadly linear, green or slightly tinged with purple, scarious-margined, 3–4 mm. long, pubescent as are the pedicels: petals white or purplish, linear-spatulate, nearly twice the length of the calyx: pods 4–6 cm. long, about 2 mm. wide, pendant on abruptly deflexed pedicels, 5–8 mm. long: seeds in two rows, oval, about 1 mm. long.

Its nearest ally seems to be *A. pulchra* Jones. Rather frequent and abundant on sage-brush plains in the southern part of the state. It seeks the rich, loose loam among the brush where it develops early.

Type specimen in Herb. University of Wyoming, no. 4523, Evanston, June 4, 1898.

Arabis lignifera

Perennial from a branched, lignescent base surmounting a woody taproot, 2–4 dm. high: annual stems usually several, erect or decumbent at base, simple below, somewhat branched above, from minutely stellate-pubescent to glabrous: leaves finely stellate-pubescent, entire, mostly basal, the conspicuous ones crowded on one or more short barren branches from the lignescent base, oblanceolate, 3–5 cm. long, tapering into a slender petiole as long or longer; those on the woody caudex oblong-oblanceolate, 10–20 mm. long, on slender petioles 2–3 times as long as the blade; cauline leaves, all but the lowest, short-auriculate, acute, narrowly oblong below, lanceolate above, 2–4 cm. long: raceme from simple to paniculately branched, nearly or quite naked, glabrous or slightly pubescent on the pedicels: sepals oblong, obtuse, veinless, scarious margined, about 4 mm. long: petals white to pinkish, spatulate, twice as long as the sepals: pods from widely divaricate to pendulous, 3–4 cm. long, nearly 2 mm. wide; valves 1-nerved: seeds almost as broad as the valves, very narrowly winged, orbicular, at maturity in one irregular row.

The woody perennial base allies it to *A. suffrutescens* Gray, but its leaf, floral and fruit characters are quite different. It may be considered somewhat doubtfully a member of the section *Turritis*. It occurs rather scatteringly in the draws among the Green River Cliffs where it seeks the protection of the sage-brush. Type specimen no. 4711, Green River, June 4, 1898.

Lesquerella prostrata

Perennial: pubescence stellate throughout, dense, appressed: taproot woody, vertical, crown simple or branched: stems several, 5–20 from each crown, usually slender and flexuous-spreading, 10–15 cm. long (including the raceme) sometimes shorter and ascending: leaves crowded on the crowns, rhomboidal, oval or oblong, 3–15 mm. long, on petioles 2–4 times as long: cauline leaves few, oblanceolate to linear: raceme in fruit half the length of the stem: pedicels ascending or somewhat recurved, 5–10 mm. long: flowers somewhat congested, medium size: sepals ovate, delicately veined, somewhat unequal, the alternate ones with a scarious inflexed margin, about 5 mm. long: petals obovate or broadly spatulate, a little less than twice the length of the sepals: pods broadly ovate, not compressed; septum elliptic, mostly perforate: the valves slightly gibbous at base: style hardly equaling the length of the pod: ovules few, seeds only 1 or 2 in each cell.

The affinities of this plant seem to be with *L. spathulata* Rydberg, though of this I have not seen a specimen. It was secured on stony, gravelly slopes of Unita Co.; not plentiful. Type specimen in Herb. University of Wyoming, no. 4564, Piedmont, June 7, 1898.

Lepidium ramosissimum

Biennial, 2–4 dm. high, obscurely pruinose-pubescent, profusely branched, the branches either divaricate and crowded the whole length of an excurrent stem or diffusely spreading from the base, the branches also divaricately ramose: taproot stout, mostly perpendicular, only moderately long, producing but few, slender, divaricate branches: first year's leaves crowded on the crown, pinnately coarsely toothed, the teeth simple or incisely cusped, oblanceolate in outline, 2–4 cm. long on petioles about equaling the blade, falling away during the winter and early part of the second season: second year's leaves cauline, smaller, numerous, sessile, the lower oblanceolate, laterally incisely few-toothed, three-toothed at apex, the middle tooth triangular and much the largest: upper leaves mostly entire, from linear to oblong: petals white, very small, narrowly spatulate, scarcely more than than half the length of the 1 mm. long oblong sepals: racemes very numerous, excessively crowded, the whole plant a relatively compact subglobose or conical mass of capsules from the ground up: capsules nearly smooth, broadly ovate, 3 mm. long on pedicels of about equal length, sinus relatively wide and shallow: seeds brown, subelliptic, not evidently margined: cotyledons incumbent.

For some time it has seemed probable that the *Lepidium* so common on the Laramie plains was not to be included under any of the described species. The incumbent cotyledons separate it at once from *L. Virginicum* L.; its undoubted biennial duration, short petals and bushy-branched habit separate it from both *L. Virginicum* and *L. medium* Greene, the only two to which it is closely allied.

This species has been distributed by me under nos. 1424 and 3356.

Lepidium ramosum

Biennial: taproot vertical, its rootlets slender and widely spreading: closely and corymbosely branched from the base, 15–20 cm. high, minutely granular-pubescent: leaves of the first season clustered on the crown, oblanceolate, serrate, or more rarely pinnatifid, petioled, falling away early the second season: cauline oblanceolate, entire, or sparingly serrate, comparatively large (3–5 cm. long): racemes numerous, many-flowered, contracted near the summit: pedicels spreading after anthesis, about equaling the capsule: petals spatulate, about equaling the wider subacute sepals: stamens 2: capsule orbicular, 3 mm. in diameter, smooth, obscurely veined, narrowly winged around the summit, the sinus relatively deep and narrow: seeds broadly semi-ovate, straight edged on the side of the cotyledons, narrowly winged at summit and on the curved side: cotyledons incumbent.

A few specimens of this species were distributed as *L. medium* Greene under no. 3092, Point of Rocks, June 1, 1897, but it will be seen from the foregoing description that it is closer to *L. apet-*

alum Gray, except in the petals. Its bushy-branched habit and biennial duration easily distinguish it. It is common throughout the Red Desert region of Southern Wyoming where it was first observed in 1897. Closer examination in 1898 shows that it is exceedingly abundant and remarkably uniform in size and habit.

Type specimen in Herb. University of Wyoming, no. 4682, Granger, June 13, 1898.

Streptanthus Wyomingensis

Biennial or possibly of longer duration: stems single or more often several from the crown, each usually somewhat branched, 2–5 dm. high (including the raceme), glabrous or nearly so throughout: leaves numerous, the radical laciniate-toothed, obovate on short margined petioles, early deciduous the second season; cauline (all except the lowest) clasping-auriculate, the lobes comparatively large and rounded, somewhat glaucous, the lowest coarsely dentate or nearly entire, oblong, 4–7 cm. long, the upper entire, gradually smaller upward: flowers large, ebracteate, congested during anthesis: calyx subcylindric; sepals oblong, 5 mm. long, petaloid, midvein greenish, especially toward the tip: petals white, sometimes tinged with pink as are the sepals, 10–12 mm. long, claw narrow, the limb spreading, nearly oval: stamens distinct, anthers nearly equaling the filament: pods slightly flattened, very variable in length, sometimes nearly 10 cm. long, only 1–1.5 mm. in diameter, erect or spreading, usually somewhat curved, on short (8 mm. long), stout, divaricate pedicels: stigma nearly sessile, 2-lobed: cotyledons accumbent.

A very distinct species of the dry desert region of south-central Wyoming where it occurs mostly as scattering specimens. Three collections of it have been secured, viz., at Green River in 1897, no. 3034; near the same place in 1898, no 4722, and at Tipton, no. 4787. Plants are in their prime during the first weeks of June, which must be considered early in the season at this high altitude.

Thelepodium paniculatum

Perennial, glabrous and somewhat glaucous throughout: taproot woody, vertical, usually simple: rootlets few to numerous, spreading: stems single, rarely 2 or more from the crown, simple below, at length paniculately branched above: radical leaves oblong, acute, tapering gradually to both base and apex, very short petioled, 2–6 cm. long: cauline sagittate-clasping, auricles short, subacute, from oblong below to narrowly lanceolate above, the lower comparatively large (4–6 cm. long), diminishing upward: raceme closely corymbose during anthesis: sepals oblong-spatulate, slightly hooded at the tip, tinged with purple, about 4 mm. long: petals white or purplish, fully twice the length of the sepals, claw narrow, the limb obovate with a rounded or nearly truncate summit: pod nearly erect, subterete, slightly narrowed into a short, stipe-like base, 20–30 mm. long: style short but evident: pedicels ascending, 8–12 mm. long.

During the past few years specimens have been accumulated that have been doubtfully called *T. sagittatum* Endl. but two recent collections make it quite evident that this *Thelepodium* of southern Wyoming is distinct.

It seems to prefer moist ground among the sage brush on low lands adjacent to streams. Type specimen, no. 4673, Fossil, Uinta Co., where it is common on Twin Creek bottoms, June 12, 1898.

Lupinus alpestris

Perennial from stout, deep set roots: caudex woody, branched, producing one or more stems from each crown: stems annual but the subligneous bases often persistent, only moderately stout, nearly erect, 4–6 dm. high, striate, very short pubescent, simple, or corymbosely branched: leaflets 5–9, mostly 7, from narrowly oblong to spatulate or oblanceolate, narrowed or cuneate at base, apex obtuse and usually cusped, very variable in length (2–7 cm.), minutely appressed-pubescent, sometimes nearly glabrous above, whole plant appearing nearly green and smooth to the unaided eye: lower petioles much longer than the leaflets, gradually shorter upward so that the uppermost do not equal the leaflets: racemes terminal on the main stem and branches, at length rather loosely verticillately flowered: calyx but slightly saccate at base, silky-villous as are the pedicels; pedicels shorter than the small to medium sized flowers: corolla blue or light blue, the keel purple-tipped, standard about 10 mm. long: pod silky-hirsute, 2–3 cm. long when mature, about 8 mm. broad, 5-ovuled, usually fewer seeded: seeds very flat, oval, 4 mm. long.

For the past three or four years this plant has been tentatively held as *L. Sitgreavesii* Wats. Opportunity, the present year, of examining authentic specimens has shown this plant to be quite distinct from that. *L. Sitgreavesii* is a coarser plant, hirsute-pubescent, flowers larger, leaflets and ovules usually more numerous; its range is in the Southwest, scarcely within the Rocky Mountains. *L. alpestris* seems to belong to the middle Rockies and is almost alpine, for it occurs, so far as observation goes, near the limit of trees. Its habitat (in Wyoming) is the loose, moist soil of the spruce woods. It has been collected in the Wind River Mts. (896); in the Sierra Madre (4243), and in the Medicine Bow Mts. (5070). The latter, the type number, by Mr. Elias Nelson, Aug. 22, 1898.

Viola vallicola

Nearly glabrous or finely puberulent, low caulescent: caudex short, erect, simple or somewhat branched at the crown: roots fascicled, fleshy, few to several: the few stems and several leaves clustered on the crowns: stems slender, with 2–4 internodes, at first very short but in age sometimes 15 cm. long: leaves entire, from broadly to narrowly ovate or oblong, mostly obtuse, with rounded base or, in the broadest leaves, subcordate, 2–5 cm. long; petioles very variable in length, about equaling the blade or in some of the radical twice as long, the uppermost cauline shorter than the blade: lower peduncles much elongated but scarcely surpassing the uppermost leaves: sepals lanceolate, glabrous: petals yellow, more or less streaked with purple, glabrous, 10–14 mm. long: pods large, oval, with numerous large ovoid seeds.

Heretofore confounded with *V. praemorsa* Dougl. which belongs to a range much to the northwest of this. That species is a much smaller plant, is nearly stemless and with coarse distant teeth on the small leaves.

The herbarium of the Missouri Botanical Garden contains but one specimen of this species beside those deposited by me, viz., Carl F. Baker's from Cameron Pass, but that is not wholly typical. It occurs in open ground, on moist, rich soil on stream banks in mountain valleys.

Collected in several places in the state, the following nos. well representing it: 43, 4340, 4345 and 4525.

Pachylophus montanus (Nutt.)

Oenothera montana Nutt.; T. & G. Fl. N. A. **1**: 500. 1840.

Root large, from 1 dm. in young plants to several dm. long in older ones, simple or somewhat branched, woody with a somewhat fleshy cortex, crowns 1 or more, strictly acaulescent: leaves from few to numerous on the crowns, the blade oblong or oblanceolate, irregularly, coarsely, pinnately toothed, acute at apex, from sparsely hirsute to green and glabrous on the faces, canescently hirsute on the margins and midrib, 3–5 cm. long, on petioles of about equal length: flowers few, calyx-tube equaling or but little shorter than the leaves, hirsute-pubescent, calyx lobes pinkish, lanceolate, glabrous but for a pubescent line down the middle, 2–2.5 cm. long: petals white, changing to pink (always drying pink), broadly obcordate, 2–3 cm. long; stamens but slightly unequal, the filaments but little longer than the anthers: capsule sessile, oblong or narrowly ovate, obscurely tubercled on the obtuse angles, 15–20 mm. long: seeds in two rows, crowded, brown or nearly black, irregularly obovate.

That this is the suppressed *Oenothera montana* there can be little doubt. Its distinctness was evident to Nuttall and must be to every one who sees it in the field. Though I have distributed it as *O. caespitosa* Nutt. (nos. 58 and 1221), the two species need never be confused. It was the evident distinctness of the two that led to the unfortunate distribution of the true *O. caespitosa* (nos. 926 and 1274) also under the wrong name.

In looking through this species cover in the Herb. Mo. Bot. Garden, I found some unnamed specimens as follows: By Hayden, two near the mouth of Wind River, May 20, 1860; one, Wind River Valley, June 29, 1860; one, Jackson's Hole, June 12, 1860; by Dr. C. M. Hines, two from the Valley of the Yellowstone, Montana (?), 1860, all of which are, without doubt, good *Pachylophus montanus*.

This plant differs strikingly from *P. caespitosus* (Nutt.) Raimann in its smaller size, its thicker, smaller leaves, smaller flowers, shorter calyx-tube, as well as in its root characters and habitat. It has been known to me for a number of years and I have never secured it except on the naked red, gravelly-clay slopes of the foothills. Here the large white flowers are very conspicuous against the red background to the night-flying insects which undoubtfully pollinate it. The changing to pink follows upon their fertilization and takes them out of competition with their neighbors.

My collection, of this species, no. 1896, Laramie, June 3, 1896, may be cited as typical.

Sphaerostigma minor

A small annual, usually simple stemmed, sometimes 2 or more erect stems from the base, 3–10 cm. high, minutely puberulent or at length glabrous: leaves rather crowded below, from linear to oblong or broader, entire, subacute, 12–25 mm. long, mostly short petioled, the radical distinctly so: flowers yellowish, minute, axillary, mostly crowded near the end of the stems: calyx-tube very short, nearly cylindrical, slightly larger upward, about as long as the narrowly ovate, obtusish segments: petals oval with acutish ends, scarcely exceeding the sepals and equalled by the pistil and the longer stamens, about 1.5 mm. long: capsule contorted or nearly straight, spreading or erect, linear, slightly attenuated upward, subcylindric, striate at maturity, obscurely puberulent: seeds in one row, oblong, subacute at the ends, smooth, about 1 mm. long.

Probably most nearly related to *Sphaerostigma strigulosa* (T. & G.) in fruit and floral characters.

An inconspicuous and scattering plant on the loose, shale cliffs bordering the Green and Platte Rivers. Type specimen in Herb. University of Wyoming no. 3047, Green River, May 31, 1897.

Peucedanum megarrhiza

Acaulescent, glabrous throughout: root enormous, semi-woody, deep-set, 1 m. (more or less) in length, 1 dm. (more or less) in diameter; caudex multicipital, very broadly caespitose, branches of caudex very numerous and crowded, thickly clothed with old leaf-sheaths: leaves few to several from each crown, rather rigidly erect, long petioled, pinnate; leaflets few, 2–5 rather distant pairs, from simple and narrowly linear to pinnatifid, 2–4 cm. long, when pinnatifid the segments few, linear or narrowly oblong, cuspidate as are the leaflets: scapes moderately stout, 15–25 cm. high, scarcely exceeding the leaves: umbel 8–12-rayed, rays widely spreading, some of them at length reflexed, nearly equal (shorter in the occasionally aborted umbellets), about 15 mm. long; pedicels 1–2 mm. long; involucels of a few short-lanceolate bracts: calyx teeth very short: petals yellow: fruit elliptic-oblong, 6–8 mm. long, half as broad: seeds strongly flattened dorsally, plane on the commissural surface; lateral ribs winged, hardly half as wide as the body of the seed, the dorsal and intermediate filiform or almost none: oil tubes about 3 in the intervals, 6–10 on the commissural face.

Certainly closely allied to *P. Parryi* C. & R. but at once to be distinguished by its strongly tufted habit, the stoutish, erect scapes and leaves and by the linear leaflets and leaf segments. It occurs on dry, naked, clay ridges and slopes and on gully sides where its long, stout root anchors it, in spite of the torrents that occasionally pour over it. Two collections of it, no. 4769, Point of Rocks, June 16, 1898, and no. 4873, Chalk Mt., July 13, 1898, the latter by Mr. Elias Nelson.

Dodecatheon salinum

Crown very short, subglobose, 5–8 mm. in diameter: roots very numerous, fascicled, rather slender but somewhat fleshy: leaves 5–10 on the crown, widely spreading or merely ascending, glabrous, rather thin, in the older leaves distinctly reticulated, entire, usually elliptic, sometimes obovate or oblanceolate, obtuse, 2–4 cm. long, on slender (rarely margined) petioles from one fourth to one half as long, including the petiole about one fourth as long as the single erect scape: scape slender, 10–20 cm. high, purplish above, glabrous as is also the inflorescence: bracts few, short, oblong or spatulate, mostly obtusish: flowers from few to several (3–12), erect in bud on very short pedicels, nodding in anthesis, the erect fruiting pedicels much elongated (2–4 cm. long): segments of the corolla lilac-purple, the undivided part yellowish-white with an indistinct purplish ring near the base: stamen ring yellowish-white, shorter than the anthers; anthers purple with whitish margins: style glabrous, surpassing the stamens; capsule elliptic, probably when wholly mature somewhat exceeding the calyx, splitting from the obtuse summit into two equal valves: seeds very numerous.

The nearest ally of this seems to be *D. pauciflorum* Greene from which its smaller size, different leaves, bracts, stamens and capsule readily distinguish it. Then, too, the habitat is different. *D. pauciflorum* is of wet or boggy, meadow-like bottom lands while this occurs on moist, strongly saline flats where other vegetation is scanty.

Type specimen in Herb. University of Wyoming, no 3012, May 29, 1897. Collected again in 1898 near the same place. Under the above number a few specimens were sent out as *D. Jeffreyi* Moore, to which it bears but little resemblance.

Cuscuta Plattensis

Stems yellowish-green, moderately slender, climbing the full length of the stems of the host: flowers in either loose or dense paniculate cymes, short pedicelled: calyx lobes obtuse, suborbicular, somewhat exceeding 1 mm. in length, the tube very short:

corolla marcescent at the base of the capsule, its lobes short-ovate, obtuse, about half the length of the broadly campanulate tube, at first erect, but ultimately reflexed; tube about 2 mm. long: scales shorter than the tube, broadest at the truncate fringed summit: styles distinct, but slightly unequal, scarcely more than 1 mm. in length and not more than 1/4 the length of the mature capsule: capsule subglobose, 5 mm. in diameter when mature, indehiscent; ovules 4, usually only one maturing, seeds broadly reniform.

Though not very closely allied, this species falls into the same section with *C. tenuiflora* Engelm. It has been twice secured, both times on the upper Platte. The first time in 1896, Aug. 27, in the Cañon of the Platte, no. 2768, and the past season by Mr. Elias Nelson, Horseshoe Park, July 13, no. 5053. The host plants thus far observed are *Grindelia*, *Solidago* and *Helianthus*.

Gilia spicata deserta var. nov.

Habit of the species, but usually shorter-stemmed: stems one or more from a woody root with one or more swollen crowns, lanate: basal leaves crowded on the crowns, mostly simple, linear; the cauline pinnatifid, the divisions few (3–5), linear; leaves and divisions shorter than in the species: inflorescence crowded-spicate, in dwarf plants approaching capitate: calyx closely and minutely glandular.

To be distinguished from the species by the shorter, stouter, more woolly stems: the more crowded and glandular inflorescence; the rosulate, crowded, nearly simple basal leaves; the slender divisions of the more pinnatifid stem leaves and its habitat. The species is of the sandy foothills in the Rocky Mountains in general while this variety has been secured only on the naked, red-clay slopes of the Red Desert region. Three collections of this variety are at hand: Point of Rocks, June 15, 1898, no. 4746; Fort Steele, June 18, 1898, no. 4832; Freezeout Hills, July 10, 1898, no. 4843, the latter by Mr. Elias Nelson.

Phacelia biennis

Biennial: root small, somewhat fleshy, conical, nearly straight and vertical, 5–8 cm. long, rarely much exceeding 10 mm. in diameter at the crown: stems strict, a single main stem from the crown 3–4 dm. high, with occasionally one or two smaller, erect accessory ones, closely canescent and slightly hispid with spreading hairs:

leaves rather numerous on the crowns, few and distant on the stems, simple or more generally with a pair of divergent, lanceolate lobes on the petiole near the base of the blade, appressed-hirsute, with a finer pubescence intermingled; blade oblong, subacute, 5–10 cm. long, 1–3 cm. wide: petioles broad, the lower about equaling the blade, shorter upwards, the upper leaves nearly sessile: inflorescence at first crowded, the cyme becoming more open with age as its short circinate spikes unroll and lengthen: sepals oblong-linear, in anthesis shorter than the corolla, lengthening with age, in fruit about 8 mm. long: corolla light blue, about 5 mm. long, the lobes obtuse, entire or nearly so, half the length of the tube, appendages inconspicuous and thin, united at the base of the filament: the filaments exserted, distinctly hirsute; style divided about half its length, glabrous.

At once distinguished by its small, biennial root, its strict habit, its ample leaves and accessory leaflets and hirsute stamens. Its habitat too is quite different from the other species, as this occurs in the moist loam of mountain valleys. Type specimen in Herb. University of Wyoming, no. 1323, Pole Creek, June 27, 1895.

Castilleia fasciculata

Perennial: taproot short, more or less branched below: caudex very short, scarcely more than a woody enlarged crown on the taproot: stems from a few to several from the crown, simple or nearly so, moderately slender, somewhat spreading at the base, very strict and fascicled above, cinereous-pubescent as are also the leaves and inflorescence (pubescence somewhat unequal—from puberulent to subhispid), 2–3 dm. high: leaves very variable, 3–6 cm. long, from nearly linear-entire to much divided, the lobes short or the leaves divided much beyond the middle, usually 3-lobed, the lateral lobes linear, widely divergent and shorter than the middle: inflorescence early elongating into a close, rather slender spike, 8–18 cm. long, constituting half, or even more, of the length of the stem: bracts not conspicuously colored, light green or indistinctly reddish or yellowish, 14–18 mm. long, 3-cleft below the middle from a broad base, the middle lobes lanceolate, nearly as long as the corolla, the lateral lobes linear, divergent, shorter than the middle one: calyx equally cleft before and behind, the lobes short-bifid: corolla hardly exceeding calyx and bracts, galea short, not more than half as long as the tube, and twice as long as the lip: lip slightly ventricose but not callous, its three teeth short-oblong, obtuse, as long as the ventricose portion: stamens mostly included in the galea; style exserted.

Closely allied to *C. viscidula,* but lacking the viscidity and easily distinguished by the strict habit of the somewhat fascicled stems. Collected by Mr. Elias Nelson, at Indian Grove Mountains, on fertile soil, in a draw among the sage-brush, July 18, 1898, no. 4998.

Some new Species from Washington

By K. M. Wiegand

(Plate 355)

The several sets of Washington plants collected by Mr. J. B. Flett afford the following apparently undescribed species. Two of these are from the vicinity of Tacoma and are already represented in the larger herbaria under other names. Those from the Olympic Mountains I have never seen from elsewhere.

Allium crenulatum

Very low and dwarf (4–5 cm. high), from a small globose bulb, the latter not fibrillar: scape 2-edged (1.25 mm. wide), edges crenulately roughened: leaves 3–4 cm. long, narrow (1.5 mm. wide), recurved, edges crenulate: umbel few-flowered: bracts two, large, scarious, ovate-oblong, acute (8–10 mm. long): pedicels shorter than the flowers: perianth pink, segments (8 mm. long) lanceolate, acutish: stamens one-half the length of the perianth: anthers short-oblong: filaments naked: ovary six-crested at the summit but not horned: style 1 mm. long. [Plate 355.]

Loose gravel near the summit of the Olympic Mountains in the vicinity of the headwaters of the Quilcene River.

Related to *A. pleinanthum* Wats. but is smaller, with roughened angles to the scape, and has fewer flowers; the leaves are also much narrower.

Lathyrus Torreyi tenellus var. nov.

Very slender and weak, more or less decumbent at the base (10–25 cm. high) from a very slender rootstock, short-hirsute with crisp white hairs intermixed with a few sessile glands: leaves (4–5 cm. long) oblong: leaflets 5–7 pairs, small, thin, elliptical, acute at each end, mucronately pointed, light green (12–16 mm. long), sparingly hairy on both surfaces; pulvinus strongly hirsute; stipules (8 mm. long) semi-ovate-lanceolate, acuminate and hastate, the lower lobe acute; rachis scarcely prolonged beyond the upper leaflet: flowers (15–17 mm. long) 1–3 (mostly 2) on a slender hirsute peduncle 1–6 cm. long; pedicels scarcely any: calyx campanulate (6–7 mm. long), 5-toothed, the upper teeth deltoid ovate, acute, the three lower subulate and nearly twice as long, sparingly hairy: corolla showy.

Oregon and Washington. The type is Flett's no. 276, collected at Tacoma; other specimens studied are:

Oregon, Hall, no. 117.

Washington, Henderson, Cooper.

The type of this species is stouter, less hirsute and has larger (15–20 mm. long) more oval leaves which are not so acute at the ends. The flowers are also smaller, commonly solitary and nearly sessile. The calyx is more deeply cleft, and the teeth longer, especially the upper. It has a more southern range from Santa Cruz to Oregon.

Hydrophyllum congestum

Stem 20 30 cm. high, rather weak, pubescent with sparse crisp hairs, sparsely branched: the cauline leaves 2–3 in number (20 cm. or less in length), pinnately 5-foliate, on rather long petioles; leaflets ovate-oblong, acute, the upper much larger and broadly ovate, all cleft incised and sharply toothed (3–5 cm. long) green and strigose above, crisp-pubescent and paler beneath: flowers in dense and nearly sessile clusters; the peduncles very short (15–20 mm. long); pedicels slender (8 mm. long), finely and crisply pubescent with tawny hairs: calyx small (5 mm. long), cleft nearly to the base, sinuses rounded, naked; lobes linear, obtuse (rarely acutish), 1-nerved, margins and surfaces densely clothed with tawny hairs intermixed with shorter ones: corolla short (8 mm. long) glabrous, cleft two-thirds of the way to the base, lobes oblong, rounded or slightly retuse at the appex; folds extending two-thirds of the way up, rather narrow, cellular-striate and glandular-ciliate: stamens with slender filaments 12 mm. long; anthers oblong (2.35 × 1.25 mm.) cordate at the base, rounded and apiculate at the summit: style forked at the tip, 12 mm. long.

Collected near Tacoma in 1896.

This species resembled *H. Virginicum* but differs in the more numerous leaflets, in the brownish hirsute covering of the nearly sessile inflorescence, and the densely hirsute calyx lobes. It also resembles *H. occidentale* Gray and *H. albifrons* Heller from which it differs principally in the short peduncles and form of the leaflets. *H. tenuipes* Heller has very long peduncles, the calyx is merely ciliate, and the hairs are not distinctly tawny.

Senecio Flettii

Slender (20 cm. high), entirely glabrous, apparently slightly fleshy: leaves mostly radical (8–12 cm. × 2 cm.), narrowly oblong, pinnately incised and parted and somewhat lyrate; divisions decurrent, oblong or more commonly obovate-cuneate, incisely toothed above, terminal portion of the leaf not enlarged, petioles as long as the blade, slender; cauline leaves 3–4, much smaller, upper quite small and with distant linear (6–8 mm. long) divisions: heads several in a capitate corymb, small (7 mm. high), on slender glabrous bracted pedicels: involucre narrowly campanulate; bracts 10–12, linear-lanceolate, thin, mostly acute, 1–2-nerved and green, whiter on the margins but scarcely scarious, calyculate outer bracts usually wanting: ray flowers only 2 or 4, longer than the disk, bright orange: achenes obovate, truncate, glabrous; pappus copious, white: tube of the corolla slender; limb elliptic (8 mm. long), the rounded apex 3–4-toothed: style slender: stigmas scarcely truncate: disk flowers numerous, orange: achenes and pappus same as in the ray flowers: corolla slender, evenly funnel-form, narrow, glabrous; lobes 5, acute: stamen-tube rather short, apex of the stamens obtuse, cubical tissue of the filament not enlarged: stigmas truncate. [Plate 355.]

Loose stones and gravel near the headwaters of the Quilcene river, Olympic Mountains.

This species belongs to the group represented by *S. Bolanderi* Gray, *S. laetiflorus* Greene, and *S. indecorus* Greene, but differs from the known species in its peculiarly lobed leaves, naked stem, and small glabrous heads. The early root leaves in some cases show a tendency to become orbicular and merely crenate.

Some Northwestern Erysiphaceae

BY DAVID GRIFFITHS

The following list is prepared from material which has been accumulating since 1892. It is based upon specimens from South Dakota, Wyoming and Montana. The species recorded from the two latter States are in the nature of incidental gatherings which were made while engaged in other work during the summers of 1897 and 1898 in company with either Mr. L. W. Carter or Mr. T. A. Williams. Access has been had to the private herbarium and collections of Mr. Williams, and several hosts and one species are quoted from these collections. The list is by no means even approximately complete for the region covered. It is published simply as a preliminary list to which additions will doubtless be made when other localities are visited.

As might be expected from a knowledge of the altitudinal and climatic variations of the states mentioned, the species are exceedingly variable in both macroscopic and microscopic characters. These variations have been quite thoroughly worked out by Professor T. J. Burrill in Ellis & Everhart, N. A. Pyrenomycetes, but the variations here are in many cases still greater than recorded by either him or Dr. Rehm in Rabenhorst's Kryptogamen Flora. I find my material variable, especially in the extent of mycelial development and the usual microscopic measurements. In the matter of appendages, character of the wall of the perithecium and number of spores and asci I find less variation from published descriptions.

As to the identity of the species recorded here, there are two points regarding which there is some doubt. *Erysiphe cichoracearum* growing on *Bigelovia*, *Lygodesmia* and *Grindelia* appears to me to have some constant characters of its own. This I find to be the case in various exsiccatae which I have examined as well as in my own collections. The characteristics which appear to be the most distinctive are the abundant development of mycelium which gives a different appearance from the forms on the other composites even to the naked eye; and the number of asci and the lighter colored appendages are also quite characteristic. *Microsphaera diffusa* and *M. Ravenelii* are quite difficult of separation, especially in the immature condition. After careful examination of well authenticated specimens named by the describers, or duplicate specimens of the type material, I have referred my specimens on *Lathyrus* to *M. Ravenelii* and the forms on *Vicia* to *M. diffusa*. Attention might be called in passing to the necessity of good descriptions of the conidial stage of the Erysiphaceae as well as of the perithecial one. Some of my material shows good characters in the early condition of development.

An interesting observation regarding the apparent sudden appearance of *E. communis* on several species of *Polygonum* is worth recording. As stated before, the collection of fungi was begun in South Dakota in 1892, but no specimens of *E. communis* were found on *Polygonum* until 1895, when I found a few immature specimens in the northern part of the state, and Mr. Williams reported it from Brookings the same year. The next year more of it was found, and in 1897 and 1898 it was abundant everywhere. The fungus without doubt occurred on species of *Polygonum* long before we happened to find it; but that it occurred in small quantity previous to 1896 there can be no doubt.

It is interesting to compare the vertical distribution of these species. This is governed mainly, no doubt, by the habits of the hosts; but as some of the host plants recorded here are found at a much higher altitude and others at a much lower, the question naturally arises as to the extent of altitudinal influence. The following upper limits will be instructive:

ERYSIPHE COMMUNIS on *Oenothera albicaulis*, 6500 ft.

ERYSIPHE CICHORACEARUM on *Mertensia Sibirica*, 8500 ft.

ERYSIPHE GRAMINIS on *Agropyron tenerum*, 8500 ft.

MICROSPHAERA VACCINII on *Vaccinium Myrtillus microphyllum*, 8500 ft.

SPHAEROTHECA CASTAGNEI on *Arnica cordifolia*, 9500 ft.

SPHAEROTHECA HUMULI on *Viola Canadensis*, 7500 ft.

The altitudes are all given for localities on Clear Creek in the Big Horn Mountains in the vicinity of Buffalo, Wyo., where quite a complete collection was made from the base of the mountains to the snow line, which here is located at about 10500 ft. *Sphaerotheca Castagnei* was found at the highest level on *Arnica cordifolia*. This host is very abundant here at lower altitudes, but this was the only locality in which it was found affected with this fungus.

Some attention has been paid to the distribution of the fungi on closely related hosts of the region. A study of the list will furnish the best general idea on this point. *E. cichoracearum* has been found, as usual, on a great number of hosts and in several instances widely separated ones. While its favorite habitat appears to be on the composites it is by no means confined to this group. When these facts are taken into consideration it is rather astonishing to find an entire absence of the fungus on hosts which are generically related. A striking illustration came under my observation at Sheridan, Wyo. In the corner of a garden three species of the genus *Artemisia—A. Ludoviciana*, *A. tridentata* and *A. longifolia* were growing in profusion. They were in such close proximity that their branches were actually intertwined. Being in partially cultivated ground the growth of each was much more luxuriant than usual. *A. Ludoviciana* was loaded with *E. cichoracearum*, but careful search failed to reveal any on the other two species. I am not aware that the fungus has ever been recorded on either of these two species. This is all the more astonishing when we consider the frequency with which *A. Ludoviciana* is affected. In the absence of direct experimental evidence no positive reason can be given for the absence of this fungus on the two species in question under such apparently favorable conditions. Although closely related there is, however, a great difference in the aromatic principle and the development of trichomes in the two species, which may account for the phenomenon at least in part. A parallel case was observed in two other species of the same genus at Buffalo, Wyo. *A. dracunculoides* and *A. Canadensis* were growing together. The former had an abundance of *E. cichoracearum* upon it while the latter was entirely free. A directly opposite effect even in widely separated hosts was observed at Missoula, Mont. Here *Crataegus* and *Alnus* were growing so that the branches overlapped. The former was badly affected with *Phyllactinia suffulta* and the latter with *Microsphaera alni*. A small quantity of *P. suffulta* was found on the *Alnus* also.

ERYSIPHE CICHORACEARUM DC.

On *Verbena stricta* Vent., Oakwood, S. D.
Artemisia Ludoviciana Nutt., Missoula, Mont.; Aberdeen, S. D.; Sheridan, Wyo.; Ft. McKinney, Wyo.
Artemisia dracunculoides Pursh, Pierre, S. D.; Billings, Mont.; Buffalo, Wyo.
Achillea millefolium L., Sylvan Lake, S. D.
Boltonia asteroides L'Her., Aberdeen, S. D.
Rudbeckia hirta L., Sylvan Lake, S. D.
Ambrosia trifida L., Pierre, S. D.
Ambrosia psilostachya DC., Huron, S. D.; Billings, Mont.
Bigelovia graveolens albicaulis Gray, Merino, Wyo.; Ft. McKinney, Wyo.
Solidago nana Nutt., Inyan Kara Mt., Wyo.
Solidago Canadensis L., Tacoma Park, S. D.
Helianthus rigidus Desf., Aberdeen, S. D.
Helianthus annuus L., Missoula, Mont.
Helianthus tuberosus L., Redfield, S. D.
Helianthus giganteus L., Big Horn, Wyo.
Helianthus Maximilianus Schard., Aberdeen, S. D.
Hydrophyllum Virginicum L., Big Stone Lake, S. D.
Aster laevis L., Missoula, Mont.
Chrysopsis villosa Nutt., Buffalo, Wyo.
Helenium montanum Nutt., Missoula, Mont.
Mertensia Sibirica Don., Buffalo, Wyo.
Phacelia circinata Jacq., Missoula, Mont.
Galium triflorum Michx., Missoula, Mont.
Carduus altissimus L., Ft. McKinney, Wyo.
Grindelia squarrosa Donal, "L. A. K." Ranch, S. D.; Aberdeen, S. D.; Ft. McKinney, Wyo.
Balsamorrhiza sagittata Nutt., Buffalo, Wyo.
Macrocalyx nyctalea (L.) Kuntze, Big Stone Lake, S. D.
Lygodesmia juncea Don., Buffalo, Wyo.
Erigeron macranthus Nutt., Bear Lodge Mts., Wyo.

ERYSIPHE COMMUNIS (Wallr.) Fr.

On *Polygonum ramosissimum prolificum* Small, Rapid City, S. D.
Polygonum ramosissimum Michx., Rapid City, S. D.; Pierre, S. D.; Billings, Mont.

Polygonum littorale Link., Grindstone Buttes, S. D.
Polygonum aviculare L., Buffalo, Wyo.; Rapid City, S. D.
Lupinus sericeus Pursh, Inyan Kara Mt., Wyo.
Thalictrum purpurascens L., Tacoma Park, S. D.
Spiesia Lamberti (Pursh) Kuntze, Grindstone Buttes, S. D.; Buffalo, Wyo.
Ranunculus Pennsylvanica L., Little Mo. Buttes, Wyo.
Homalobus cespitosus Nutt., Inyan Kara Mt., Wyo.
Lotus Purshiana (Nutt.) Bisch., Belle Foursche, S. D.
Oenothera albicaulis Nutt., Buffalo, Wyo.
Trifolium varigatum Nutt., Lo Lo, Mont.
Psoralea tenuiflora Pursh, Billings, Mont.
Astragulus oroboides Americanus Gray, Buffalo, Wyo.
Astragulus frigidus Americanus (Hook.) Watson, Buffalo, Wyo.
Astragalus Canadensis L., Tacoma Park, S. D.
Lespedeza striata Hook. & Arn., Brookings, S. D.

ERYSIPHE GALEOPSIDIS DC.

On *Stachys palustris* L., Missoula, Mont.; Aberdeen, S. D.; Ft. McKinney, Wyo.; Huron, S. D.

ERYSIPHE GRAMINIS DC.

Poa nemoralis L., Bear Lodge Mts., Wyo.; Hot Springs, S. D. Lake Hendricks, S. D.
Poa serotina Ehr., Missoula, Mont.
Poa pratensis L., Ft. McKinney, Wyo.; Brookings, S. D.
Bromus unioloides Willd., Brookings, S. D.
Bromus breviaristatus (Hook.) Buckl., Buffalo, Wyo.; Missoula, Mont.
Agropyron tenerum Vasey, Buffalo, Wyo.
Beckmannia erucaeformis Hort., Belle Foursche, S. D.

SPHAEROTHECA CASTAGNEI Lev.

On *Lepargyraca argentea* (Nutt.) Greene, Sheridan, Wyo.; Devil's Tower, Wyo.
Lepargyraea Canadensis (L.) Greene, S. Fork Piney River, Wyo.
Troximon officinalis Weber, Billings, Mont.
Crepis runcinata T. & G., Buffalo, Wyo.
Arnica cordifolia Hook., Buffalo, Wyo.

Gillardia aristata Pursh, Missoula, Mont.
Troximon glaucum Pursh, Buffalo, Wyo.; Red Lodge, Mont.
Pedicularis Groenlandica Retz., Buffalo, Wyo.
Fragaria glauca (Watson) Rydb., Missoula, Mont.
Collomia linearis Nutt., S. Fork Piney River, Wyo.
Senecio triangularis Hook., Red Lodge, Mont.
Lophanthus anisatus Benth., Little, Mo.; Buttes, Wyo.
Bidens frondosa L., Scatterwood, S. D.

SPHAEROTHECA HUMULI (DC.) Burrill

On *Viola Canadensis* L., Buffalo, Wyo.
Geranium Richardsoni Fisch., Bear Lodge Mts., Wyo.
Humulus Lupulus L., Buffalo, Wyo.

SPHAEROTHECA EPILOBII (Link.) DeB.

On *Epilobium adenocaulon* Hausskn., Sylvan Lake, S. D.; Buffalo, Wyo.

SPHAEROTHECA MORS-UVAE (Schw.) B. & C.

On *Ribes lacustre* Prior., Buffalo, Wyo.
Ribes Hudsonianum Richards, Missoula, Mont.
Ribes floridum L'Her., Rondell, S. D.

SPHAEROTHECA PANNOSA (Wallr.) Fr.

On *Rosa Woodsii* Lindl., Ft. McKinney, Wyo.

PODOSPHAERA OXYACANTHAE (DC.) DeB.

On *Spiraea lucida* Dougl., S. Fork Piney River, Wyo.
Prunus Americana Marshall, Redfield, S. D.
Prunus Virginiana L., Bigstone Lake, S. D.
Prunus demissa Walp., S. Fork Piney River, Wyo.
Prunus pumila L., Brookings, S. D.
Crataegus rivularis Nutt., Little, Mo.; Buttes, Wyo.

PHYLLACTINIA SUFFULTA (Reb.) Sacc.

On *Philadelphus Lewisii* Pursh, Missoula, Mont.
Betula occidentalis Hook., Ft. McKinney, Wyo.
Crataegus rivularis Nutt., Missoula, Mont.
Cornus stolonifera Michx., Missoula, Mont.; Big Stone Lake, S. D.

Alnus incana virescens Watson, Missoula, Mont.
Negundo aceroides Moench., Brookings, S. D.
Fraxinus viridis Michx., Brookings, S. D.
Celastrus scandens L., Brookings, S. D.

MICROSPHAERA SYMPHORICARPI E. C. Howe

On *Symphoricarpos occidentalis* Hook., Tacoma Park, S. D.
Symphoricarpos racemosus Michx., Missoula, Mont.

MICROSPHAERA VACCINII C. & P.

On *Vaccinium Myrtillus microphyllum* Hook., Buffalo, Wyo.

MICROSPHAERA ALNI (DC.) Wint.

On *Syringa vulgaris* L., Brookings, S. D.
Euonymus atropurpureus Jacq., Brookings, S. D.
Alnus incana virescens Watson, Missoula, Mont.
Lonicera glaucescens Rydb., Bear Lodge Mts., Wyo.

MICROSPHAERA QUERCINA (Schw.) Burrill

On *Quercus macrocarpa* Michx., Little, Mo.; Buttes, Wyo.

MICROSPHAERA DIFFUSA C. & P.

On *Vicia Americana truncata* (Nutt.) Brewer, Snoma, S. D.
Vicia linearis (Nutt.) Greene, Brookings, S. D.
Vicia Americana Muhl., Buffalo, Wyo.
Glycyrrhiza lepidota Pursh, Little Mo. Buttes, Wyo.

MICROSPHAERA RAVENELII Berk.

On *Lathyrus vinosus* Muhl., Sylvan Lake, S. D; Bear Lodge Mts., Wyo.

UNCINULA SALICIS (DC.) Wint.

On *Salix cordata* Muhl., Aberdeen, S. D.
Salix sp., Little Mo. Buttes, Wyo.
Populus tremuloides Michx., Sylvan Lake, S. D.; Red Lodge, Mont.
Populus balsamifera L., Buffalo, Wyo.

UNCINULA MACROSPORA Peck.

On *Ulmus Americana* L., Brookings, S. D.

UNCINULA NECATOR (Schw.) Burrill.

On *Parthenocissus quinquefolia* (L.) Planch, Brookings, S. D.

COLUMBIA UNIVERSITY, March 1, 1899.

An Enumeration of the Plants collected by Dr. H H. Rusby in South America, 1885–1886.—XXVI

By H. H. Rusby

(Continued from Bull. Torr. Bot. Club, **25** : 545. 15 O. 1898.)

5–7 cm. long, branched, the branches elongated, very slender, spreading : leaves sessile by a broad base, those of the pair contiguous, 4–10 cm. long, .5–1.5 cm. broad, lance-linear, tapering from near the base and attenuate, strongly nerved, the principal nerves 5–7 : cymes terminal, rather dense, 3–5 cm. broad, closely subtended by leaves similar to the others, though smaller : pedicils 5–10 mm. long, stoutish, strongly angled ; calyx-tube hemispherical-campanulate, 3 mm. long, 4 mm. broad, the lobes 4 or 5 mm. long, attenuate from a broad base, the sinuses broad and rounded : corolla (apparently yellow), nearly 1 cm. long and broad, the lobes 7 mm. long, obovate, the apex rounded, minutely toothed : stamens inserted about 2 mm. from the base, 6 mm. long, the filaments broad, the anthers black, 1 mm. long and nearly as broad, attached by a very broad connective ; stigmas broad, oval, exserted about 1 or 2 mm.

Ingenio del Oro, 10000 ft., Mar., 1886 (nos. 672 and 673).

Tetragonanthus gracilis (Griseb.) Kuntze, Rev. Gen. Pl. 431. Sorata and Unduavi, 10000 ft. (nos. 669 and 670). Grows on wet hillsides, in clearings.

Limnanthemum Humboldtianum (H.B.K.) Griseb. Gen. et Sp. Gent. 347. (*Villarsia Humboldtiana* H.B.K. Nov. Gen. et Sp. **3** : 187.) Reis, 1500 ft., June, 1886 (551). Grows in shallow pools.

HYDROPHYLLACEAE.

Phacelia Peruviana (R. & P.) Spreng. Syst. **1** : 584. Sorata, 8000 ft., Apr., 1885 (1157).

BORAGINACEAE.

Cordia discolor C. & S. Linnaea **4** : 482. 1829. Yungas, 6000 ft., 1885 (2051).

Cordia excelsa (Mart.) A. DC. Prod. **9** : 473. (*Gerasa-*

canthus excelsa Mart. in Flora **21**^{2}: Beibl. 86. 1838). Reis, 1500 ft., June, 1886 (1903).

Cordia Gerasacanthus L. Syst. 936. [10th ed.] Beni River, July, 1886 (1902).

Cordia Guayaquilensis A. DC. Prod. **9**: 496. Yungas, 4000 ft., 1885 (2344).

Cordia hispidissima A. DC. Prod. **9**: 475. Mapiri, 2500 ft., May, 1886 (no. 1901). The same as Blanchet's no. 995.

Cordia laxiflora H.B.K. Nov. Gen. et Sp. **3**: 72 (?) Junction of Rivers Beni and Madre de Dios, Aug., 1886 (no. 2054) and Falls of Madeira, Brazil, Oct. (no. 2053). The same as Spruce's no. 1695 and Bang's no. 1394 and 1443, but not Glaziou's no. 11296. If not *C. laxiflora*, it is an undescribed species.

Cordia multispicata Cham. Linnaea **4**: 490. 1829. Var. *fide* Britton. To me it appears rather *C. ferruginea* R. & S. Syst. **4**: 458. Guanai, 2000 ft., May, 1886 (no. 2345). Apparently the same as F. Müller's no. 146 from Mexico.

Cordia rotundifolia R. & P. Fl. Per. **2**: 24. *pl. 148. f. a.* Unduavi, 8000 ft., Oct., 1885 (no. 1946). The same as Eggers' no. 14001.

Cordia multicapitata Britton sp. nov.

A shrub, strongly ferruginous-pubescent upon the branches, inflorescence, and veins of the lower leaf-surfaces: branches terete, rather slender: petioles 1–2 cm. long, broadly dilated at the insertion: blades 3–12 cm. long, 2–8 cm. broad, ovate, the base blunt to rounded, the apex abruptly short-acuminate and acute, the margin serrate-dentate with short sharp salient teeth, dark-green and shortly pubescent above, ferruginous underneath, the secondaries 7–10 irregular pairs, strongly upcurved, prominent underneath, obscure above, the secondaries and tertiaries successively connecting about midway: peduncles terminal but the lower appearing axillary, solitary, slender, erect, 2–6 cm. long, the heads globoidal, dense, 1–1.5 cm. broad: flowering calyx thick and rigid, about 4 mm. long and broad, somewhat larger in fruit, divided a little below the middle, the tube hemispherical to broader, the lobes triangular-ovate, acuminate to attenuate and acute: corolla nearly twice the length of the calyx, campanulate.

Mapiri, 2,500 ft., May, 1886 (no. 1948).

Related to *C. ambigua*, of Mexico.

Cordia umbrosa Spruce MS. sp. nov.

Branches, peduncles and lower portions of the midribs underneath very sparsely hispid with long, mostly reflexed hairs: petioles (only the uppermost seen) less than 1 cm. long, blackish-brown, stout: blades about 3 dm. long, 12–15 cm. broad, oval, the base blunt, the apex very short-acuminate and acute, glabrous except as stated, membranous but rigid, dark-green, the venation slender but very prominent underneath, inconspicuous above, coarsely reticulate, the secondaries 10 or 12 on each side, mostly alternating, the base abruptly deflexed, then gradually merging into the midrib: peduncle (but one seen) terminal, 4 cm. long, the panicle cymose, loose, 2–5 cm. broad: pedicels short but distinct, stout, articulate: flowering calyx membranous, 3 mm. long, somewhat broader, open-campanulate, the lobes short, broad and obtuse: corolla-tube 4–5 mm. long and broad, campanulate with the mouth slightly contracted, a dark line descending from each sinus, the lobes about 3 mm. long, broad and rounded, abruptly spreading: stamens equaling the corolla, inclusive of its lobes: the anthers 2.5 mm. long, the spreading bases as long as the united portion of the thecae, yellow: styles apparently about equalling the stamens, filiform: stigmas capitate, conspicuous.

Junction of Rivers Beni and Madre de Dios, Aug., 1896 (no. 2608). The same as Spruce's no. 3281, and collected by Pearce at Monterico, 3000–4000 ft.

Cordia Caracasana velutina Britton var. nov.

Softly ferruginous-tomentose throughout, the branches, petioles and peduncles stout, the spikes 2–4 cm. long, 1–2 cm. broad, the leaves finely reticulate, the veins impressed above, finely serrate.

Reis, 1500 ft., June, 1886 (no. 2041) and Guanai, 2000 ft. May, 1886 (no. 2482).

Saccellium Oliverii Britton sp. nov.

Branches slender, somewhat flexuous, sparsely hispid-hairy, like the petioles and midrib: petioles 5 mm. long, stout and broad, blackish: blades 5–15 cm. long, 2–6 cm. broad, ovate, the base rounded, the apex short-acuminate and acute, membranous, obscurely strigose on both sides, the secondaries 9–12 on each side, the venation slender, reticulate, prominent on both sides, especially underneath: panicle small, terminal, short-peduncled: flowers not seen: fruit-pedicels scarcely any: fruiting calyx elliptical, about 3.5 cm. long, 2 cm. wide, tipped with a blackish induration: fruit blackish, shining, wrinkled, stoutly stipitate and beaked, oblong, slightly 4-lobed at apex, about 7 mm. long exclusive of stipe and beak, 5 mm. broad.

Guanai, 2000 ft., May, 1886 (no. 2535).

Coldenia dichotoma (R. & S.) Lehm. Asperifol. (*Lithospermum dichotomum* R. & P. Fl. Per. **2**: 5. *t. 3. f. c.*) Vic. La Paz, 10,000 ft., Apr., 1885 (no. 1430).

Tournefortia fuliginosa H.B.K. Nov. Gen. et Sp. **3**: 81. Unduavi, 8000 ft., Oct., 1885 (no. 1923).

Tournefortia laevigata Lam. Illust. **1**: 416. Reis, 1500 ft., June, 1886 (no. 1427).

Tournefortia obscura A. DC. Prod. **9**: 517. Mapiri, 5000 ft., Apr., 1886 (no. 1922). Grows in cinchona plantations, as a weed. The same as Spruce's 3886.

Tournefortia Surinamensis A. DC. Prod. **9**: 526. (No. 2049.)

Tournefortia andina Britton sp. nov.

Subglabrous, or the inflorescence, including the outer corolla surface, grayish-pubescent; branchlets stout, spreading: petioles .5–1 cm. long, slender: blades 4–8 cm. long by 1.5–4 cm. broad, oblong to lanceolate, acute at the base, acute or obtusish at apex, dark-green above with the veins impressed, pale yellowish-green underneath, the secondaries about 10 pairs, strongly upcurved, especially toward the margin: terminal panicles sessile, widely branched, the branches 5–8 cm. long, slender, recurved, the flowers sessile, not crowded: calyx 2–4 mm. long, cleft nearly to the base, the lobes lanceolate, tapering, acutish: corolla 7–10 mm. long, cylindraceous, dilated to one half broader about two thirds of the way to the summit, the lobes 1–2 mm. long, erect, on the apex somewhat recurved: fruit 5 mm. long, 6 mm. broad, globoidal with broad, truncate base, blackish brown, glabrous.

Sorata, 8000 ft., Feb., 1886 (no. 1822). Bang's no. 1775 has narrower and less pubescent corollas, while Mandon's 390 has broader and much more tomentose corollas, but I think both are of this species.

Tournefortia graciliflora sp. nov.

Glabrous, or the inflorescence and lower leaf-surfaces very minutely roughened: branches elongated, very slender, weak, angled: petioles 1.5–3 cm. long, rather stout: blades 1–1.5 dm. long, 7–10 cm. broad, oval-ovate, somewhat inaequilateral, rounded or subtruncate at the base, abruptly short-pointed and acute at the apex, very thin, very dark-green, the weak and irregular venation prominent below, the secondaries 5 or 6 pairs, with short alternating ones: panicle compound, very loose, the rachis flexuous, the branches 5–7 cm. long, very slender, horizontal or somewhat drooping: flowers about 3 mm. apart, on very short stout pedicels: calyx 1.5–2 mm. long, its alternate lobes erect: corolla 6 mm. long, its cylindrical tube 4.5 mm. long, .5 mm. broad, abruptly dilated into a hemispherical or campanulate summit nearly 2 mm. broad, the erect-spreading dark teeth 1 mm. long; mature fruit not seen.

Falls of Madeira, Brazil, Oct., 1886 (no. 1428).

Tournefortia sp.; the specimen in too young a state. Junction of Rivers Beni and Madre de Dios, Aug., 1886 (no. 1440).

Tournefortia sp.; unfit for determination. Guanai, 2000 ft., May, 1886 (no. 2464).

Heliotropium inundatum Swz. Prod. Veg. Ind. Occ. 40. Mapiri, 2500 ft., May, 1886 (no. 1435); Junction of Rivers Beni and Madre de Dios (no. 1438), and Falls of Madeira, Brazil (no. 1436), the same as Mandon's 385 and 386.

Heliotropium Indicum L. Sp. 130. Beni River, July, 1886 (no. 1433).

HELIOTROPIUM BRACHYSTACHYUM (DC.). (*Heliophytum brachystachyum* DC. Prod. **9**: 554). Near La Paz, 10000 ft. alt., 1885 (no. 2539). The same as Spruce's 5778.

Heliotropium parviflorum L. Mant. **2**: 201. Beni River, July, 1886 (no. 1434).

Heliotropium corymbosum R. & P. Fl. Per. **2**: 2. *t. 107.* Yungas, 4000 ft. 1885 (no. 1437).

Eretrichium Walpersii (A. DC.) Wedd. Chlor. And. **2**: 90 (*Antiphytum Walpersii* A. DC. Prod. **10**: 122). Yungas, Bolivia, 4000 ft., 1885 (no. 2581).

CONVOLVULACEAE

Ipomoea fastigiata (Roxb.) Sweet, Hort. Brit. ed. **1** 288; ed. II: 372 (*Convolvulus fastigiatus* Roxb. Hort. Beng. 13; Fl. Ind. **1**: 468). Guanai, 2000 ft., May, 1886 (no. 1987).

Ipomoea floribunda Moric. Pl. Nouv. Am. 46. *t. 31.* Reis, 1500 ft., June, 1886 (no. 1994). The same as Mathew's 1330. No. 1995, from Guanai, 2000 ft., May, 1886, is probably of this species also.

Ipomoea macrocalyx R. & P. Choisy in DC. Prod. **9**: 362. Guanai, 2000 ft., May, 1886 (no. 2056), and Junc. Rivers Beni and Madre de Dios, August, 1886 (no. 205). The same as Mathew's 1332 from Mayobamba.

Ipomoea sidaefolia Choisy, in Mém. Soc. Phys. Genèv. **6**: 459. 1833. (If this is a synonym of *Convolvulus domingensis* Dess. in Lam. Encyc. **3**: 554, of which I cannot satisfy myself, it should carry that specific name under *Ipomoea*). Beni River, July, 1886 (no. 1998).

Ipomoea umbellata L. Syst. Ed. **10**: 924. Guanai, 2000 ft., May, 1886 (no. 1991).

Ipomoea carnea Jacq Enum. Pl. Carib. 13; Select. Am. 26. Unduavi, 8000 ft., October, 1885 (no. 1992).

Ipomoea filipedunculata sp. nov.

Glabrous, very slender: petioles 2 cm. long, very slender; blades 3–6 cm. long, 2–3.5 cm. broad, broadly ovate, shallowly cordate, abruptly acuminate; entire, thin, dark-green: peduncles a little stouter than the petioles, 2.5–3 cm. long, about 6-flowered; pedicels very slender, mostly 5 mm. long; buds lance-ovate, acute: sepals broadly ovate, the outer acutish, 5 mm. long, the inner blunt and a little shorter: corolla 1.5–2 cm. long, apparently purplish, the mouth little expanded: material for dissection wanting.

Guanai, 2000 ft., May, 1886 (no. 1997).

Ipomoea opulifolia sp. nov.

Sericeous throughout, including the corollas in fruit, the leaves glabrous on the upper surface, and twice as large: branches stout or stoutish: petioles rather slender, in flower 3–6 cm., in fruit 7–10 cm. long: blades, in flower, 7–10 cm. long, and about as broad, shallowly cordate with the base slightly intruded upon the sinus, deeply 3-lobed, the lateral lobes acuminate and acute, lightly falcate, entire or with one lobe upon the lower side, the terminal broadly ovate (apex not seen) entire or with a pair of lobes; peduncles stout or stoutish, longer than the petioles, shorter than the leaves, about 5-flowered: pedicels 1–2 cm. long: calyx 1 cm. long, or in fruit 1.5 cm., the outer ovate, acutish, the inner oval, slightly mucronate, 1-nerved: corolla (pale-red ?) 6 cm. long: fruit globoidal, 1.5 cm. in diameter, blackish-brown, nerved.

Guanai, 2000 ft., May, 1886 (no. 1999), in fruit. Description of flowering plant taken from Mr. Bang's no. 2506.

Species near *I. argyreia.*

Batatas edulis Choisy Convolv. Or. 53. Mapiri, 5000 ft., Apr., 1886 (no. 1986). The same as Lechler's 2384.

Quamoclita hederifolia (L.) G. Don, Gen. Syst. **4**: 259: (*Ipomoea hederifolia* L. Syst. 925 [ed. 10]). Reis, 1500 ft., June, 1886 (no. 1985).

Calonyction Bona-nox (L.) Boj. Hort. Maurit. 227 (*Ipomoea Bona-nox* L. Sp. ed. 2, 228). Guanai, 2000 ft., May, 1886 (no. 1993) and Beni River, July, 1886 (no. 1990).

Pharbites heterophylla (Orteg.) Choisy in DC. Prod. **9**: 344 (*Ipomoea heterophylla* Orteg. Hort. Matr., Dec. 9). Vic. La Paz, 10000 ft., Apr., 1885 (no. 1988) and Falls of Madeira, Brazil, Oct., 1886 (no. 1989).

Jacquemontia sphaerostigma (Cav.) (*Convolvulus sphaerostigma* Cav. Ic. **5**: 54. *t. 481.—Jacquemontia hirsuta* Choisy in Mém. Soc. Phys. Genèv. viii, 1 (1838) 63). Guanai, 2000 ft., May, 1886 (no. 1844).

Jacquemontia nummularia (Vahl) Choisy Mém. Soc. Phys. Genèv. viii, **1** (no. 1838) 62 (*Convolvulus nummularia* Vahl. Eclog. Am. **2**: 13). Tacna, Mar., 1885 (no. 2007).

Jacquemontia densiflora sp. nov.

Gray-puberulent throughout or the upper leaf-surfaces green: branchlets slender: petioles 1.5–3 cm. long: blades 3–6 cm. long, 2–4 cm. broad, ovate, acuminate and acute, cordate, with broad or narrow sinus, entire, thin, the slender venation prominent underneath: peduncles mostly exceeding their leaves, the cymes 2–5 cm. broad, short-bifurcate, dense, exceedingly variable as to the number of flowers, bracted with linear attenuate bracts: pedicels very short, sepals ovate, 5–6 mm. long, including the long-attenuate tips: corollas (apparently purple) 1 cm. long, broadly campanulate with a short tube, the stamens barely included; fruit globoidal, 3 or 4 mm. in diameter, brown, the pericarp thin and delicate.

Guanai, 2,000 feet, May, 1886 (no. 1845). Bang's no. 2849 is probably a more tomentellate form of the same.

Convolvulus Bonariensis Cav. Ic. **5**: 54. *t. 480. f. 2.* Tacna, Mar., 1885 (no. 1996).

Convolvulus laciniatus Desv. in Lam. Encyc. **3**: 546. Yungas 6000 ft., 1885 (no. 1851).

Evolvulus linifolius L. Sp. ed. 2, 392. Falls of Madeira, Brazil, Oct., 1886 (no. 2009).

Dichondra argentea Willd. Hort. Ber. 297. Vic. La Paz, 10000 ft., April, 1885 (no. 2008), the same as Mandon's 1483, and Yungas, 4000 ft., 1885 (no. 1949).

Alona carnosa Lindl. Bot. Reg. (1844), sub *t. 46*. Near Valparaiso, Chili, June, 1885 (no. 2565).

Cuscuta Chilensis Ker-Gawl. in Bot. Reg. *t. 603*. Near Valparaiso, Chili, June, 1885 (no. 2001).

Cuscuta grossa Engelm. I have not been able to find the publication of this name, which occurs upon the herbarium sheets at Kew. Unduavi, 8000 ft., Oct., 1885 (no. 2003), and vic. La Paz, 10000 ft., April, 1885 (no. 2004).

Cuscuta grandiflora H.B.K. Nov. Gen. et Sp. **3**: 123. Vic. La Paz, 10000 ft., April, 1885 (no. 2006); Sorata, 8000 ft., Feb., 1886 (no. 2005), and Unduavi, 8000 ft., Oct., 1885 (no. 2002).

Cuscuta sp. Near Valparaiso, Chili, June, 1885 (no. 2000).

SOLANACEAE

Solanum amaranthifolium Gill. MS. in Herb Kew (?). I cannot find that the name has been published. The foliage is not exactly the same, but it appears to be the same as Gillies' species, collected at Buenos Ayres. Near Valparaiso, Chili, June, 1885 (no. 2557).

Solanum amblophyllum Hook. Bot. Misc. **2**: 231. 1831. Yungas, 6000 ft., 1885 (no. 806). The same as Mandon's 396 and apparently the same as Jameson's 457.

Solanum amplexicaule Sendt. in Mart. Fl. Bras. **10**: 14. Falls of Madeira, Brazil, Oct., 1886 (no. 2606).

Solanum asarifolium Kunth et Bouché Ind. Sem. Hort. Berol. (1845) 10. Guanai, 2000 ft., May, 1886 (no. 2631).

Solanum asperum Vahl. Eclog. Am. **2**: 17. Mapiri, 5000 ft., April, 1886 (nos. 722 and 788).

Solanum auriculatum Ait. Hort. Kew. ed. I., **1**: 246. Unduavi, 8000 ft., Oct., 1885 (nos. 771 and 780).

Solanum campylocladum Magdalense Dunal in DC. Prod. **13**^{1}: 173. Guanai, 2000 ft., May, 1886 (nos. 784 and 798). It is certainly an error to class this as a *Solanum*. It is probably a *Brachistus*, but the specimens lack flowers.

Index to recent Literature relating to American Botany

Arthur, J. C. & Holway, E. D. W. Descriptions of American Uredineae.—II. Bull. Lab. Nat. Hist. Iowa, **4** : 377–402. *pl. 4–12.* D. 1898.

Text for Fascicle 2 Uredineae exsiccatae et icones of same authors.

Atkinson, G. F. Method of teaching Botany in the secondary Schools. Asa Gray Bull. **6** : 102–106. D. 1898.

Baker, J. G *Fritillaria pluriflora.* Curt. Bot. Mag. **54** : *pl. 7631.* D. 1898.

Native of Northern California.

Beal, W. J. Seed Dispersal. 12mo, pp. 89. *f. 1–65.* Boston, 1898.

Boyer, C. S. New Species of Diatoms. Proc. Phila. Acad. 1898 : 468–470. *pl. 24.* 1898.

New species in *Rhabdonema* and *Biddulphia.*

Brandegee, T. S. New Species Plants of from Mexico. Erythea, **7** : 1–9. 5 Ja. 1899.

New Species in *Triumfetta, Dalea, Vernonia, Eupatorium, Erigeron, Alvordia, Leptosyne, Cordia, Cestrum, Nicotiana, Teucrium, Euphorbia, Acalypha, Phyllanthus* and *Hechtia.*

Campbell, D. H. Lectures on the Evolution of Plants. 12mo, pp. 319. *f. 1–60.* 1899.

Chesnut, V. K. Thirty poisonous Plants of the United States. U. S. Dep. Agric., Farmer's Bull. 86 : 1–32. *f. 1–24.* 1898.

Cratty, R. I. The Iowa Sedges. Bull. Lab. Nat. Hist. Iowa, **4** : 313–375. *pl. 1–10.* D. 1898.

Davis, B. M. Kerntheilung in der Tetrasporenmutterzelle bei *Corallina officinalis* L. var. *mediterranea.* Ber. deutsch. Bot. Ges. **16** : 266–272. *pl. 16–17.* N. 1898.

Galbraith, S. J. Vanilla culture as practiced in the Seychelles Islands. Bull. U. S. Dep. Agric. (Div. Botany) **21** : 1–24. *pl. 1. f. 1–2.* 1898.

Gilbert, B. D. Revision of the Bermuda Ferns. Bull. Torr. Bot. Club, **25** : 593–604. 16 D. 1898.

Adiantum bellum Walsingense, var. nov.

Greene, E. L. New western Species of Roses. Pittonia, **4** : 10–14. 31 Ja. 1899.

Greene, E. L. New Choripetalous Exogens. Pittonia, **4**: 14–16. 31 Ja. 1899; 17–21. 7 F. 1899.

New species in *Aquilegia, Ranunculus, Cleome, Draba, Thelypodium* and *Amelanchier.*

Gueguen, F. Recherches sur les organismes mycéliens des solutions pharmaceutiques. Études biologiques sur le *Penicillium glaucum.* Bull. Soc. Myc. France, **14**: 201–255. *pl.* 13–16. 31 N. 1898.

Halsted, B. D. Exposure and fungous Diseases. Bull. Torr. Bot. Club, **25**: 622–625. 16 D. 1898.

Hanausek, T. F. Vorläufige Mittheilung über den von A. Voge in der Frucht von *Lolium temulentum* entdeckten Pilz. Ber. deutch. Bot. Ges. **16**: 203–207. N. 1898.

Hasse, H. E. New species of Lichens from Southern California, determined by Professor Nylander. Bull. Torr. Bot. Club, **25**: 632, 633. 16 D. 1898.

Lecanora praecrenata, Arthonia pruinosella, Thelopsis subporinella, Lecidea triphragmioides, sp. nov.

Heller, A. A. New and interesting Plants from Western North America. Bull. Torr. Bot. Club, **25**: 626–629. 16 D. 1898.

Fendlerella and *MacDougalia*, new genera, based respectively upon *Whipplea Utahensis* S. Wats. and *Actinella Bigelovii* A. Gray; new species and new names in *Linum, Galium* and *Erigeron.*

Hooker, J. D. *Lewisia Tweedyi.* Curt. Bot. Mag. **55**: *pl. 7633.* Ja. 1899.

Native of Washington.

Hooker, J. D. *Meconopsis heterophylla.* Curt. Bot. Mag. **55**: *pl. 7636.* Ja. 1899.

Native of California.

Hollick, A. The Relation between Forestry and Geology in New Jersey. Am. Nat. **33**: 1–14, *pl.* Ja. 1899.

Hollick, A. The Relation between Forestry and Geology in New Jersey, Part II. Historical Development of the Flora. Am. Nat. **33**: 109–116. F. 1899.

Jenman, G. S. Ferns: Synoptical List LVII. Bull. Bot. Department, Jamaica, **5**: 272–277. 30. Ja. 1899.

Includes Salvineae and Gleichenieae.

Jones, L. R. & Orton, W. A. Report of the Botanists. Rep. Vt. Agric. Exper. Sta. **11**: 189–236. 1898. [Illust.]

Contains among other matter, a partial list of Parasitic Fungi of Vermont, and Notes upon Vermont weeds.

Lawson, A. A. Some Observations on the Development of the karyokinetic Spindle in the Pollen-Mother-Cells of *Cobaea scandens* Cav. Proc. Cal. Acad. Sci. (Botany) **1**: 169–188, *pl. 33–36.* 17 N. 1898.

Levier, E. Le cas du Docteur Otto Kuntze. 8vo. pp. 1–12. Florence, 1898.

Macoun, J. M. Notes on some Ottawa Violets. Ottawa Nat. **12**: 181–187. Ja. 1899.

Maire, R. Note sur la développement saprophytique et sur la structure cytologique des sporidies-levūres chez l'Ustilago maydis. Bull. Soc. Myc. France, **14**: 161–173. *pl. 12.* 31 N. 1898.

Malme, G. O. A: N. Die Xyridaceen Paraguays. Bull. Herb. Boiss. **7**: 75–78. 24 Ja. 1899.

Meehan, T. *Chimaphila maculata.* Meehan's Month. **9**: 1–2, *pl. 1.* Ja. 1899.

Nestler, A. Ueber einen in der Frucht von *Lolium temulentum* L. vorkommenden Pilz. Ber. deutsch. Bot. Ges. **16**: 207–214. *pl. 13.* N. 1898.

Orcutt, C. R. Review of the Cactaceae of the United States. II. 35–56. 20 Ja. 1899.

Peck, C. H. Report of State Botanist, 1897. Rep. New York State Museum, **51**: 267–321. *pl. A. B. 50–56.* 1898.

New species in *Lepiota*, *Clitocybe*, *Mycena*, *Omphalia* (2), *Marasmius* (3), *Leptonia*, *Pholiota* (2), *Inocybe* (2), *Flammula*, *Tubaria*, *Deconica*, *Gomphidius*, *Hygrophorus*, *Clavaria*, *Boletus*, *Poria*, *Isaria*, *Exoascus*, *Hypocrea*, and *Sphaerella*. Quarto plates represent mostly edible fungi.

Price, S. F. Trees and Shrubs of Kentucky. 6 pp. 1898.

Rothrock, J. T. *Magnolia glauca.* Forest Leaves, **7**: 8–9. *pl. 1–2.* F. 1899.

Small, J. K. Studies in the Botany of the Southern United States.—XV. Bull. Torr. Bot. Club, **25**: 605–621. 16 D. 1898.

New species in *Melanthium*, *Smilax*, *Gyrostachys*, *Oxalis*, *Physostegia*, *Euphorbia*, *Hypericum*, *Gaura*, *Verbena*, *Gerardia*, *Solidago*, *Doellingeria*, and *Aster*; the generic name *Forcipella* Small, having proved untenable, is replaced by *Gibbesia*.

Smith, J. D. An Enumeration of the Plants collected in Central America by Dr. W. C. Shannon. Intercontinental Railway Commission, 1^2: Appendix III. 1–24. 1898.

Sodiro, A. Plantae Ecuadorenses I. Bot. Jahrb. Engler, **25**: 722–733. 23 D. 1898.

New species by Gilg, Schumann and Pilger.

Stevens, W. C. Ueber Chromosomentheilung bei der Sporenbildung der Farne. Ber. deutsch. Bot. Ges. **16**: 261–265. *pl. 15.* N. 1898.

Suksdorf, W. N. Washingtonische Pflanzen. Deutsche Monats. **14**: 220–222. D. 1898.

Notes on *Claytonia* and description of *Geranium nemorale*, sp. nov.

Underwood, L. M. Two recently named Genera of Basidiomycetes. Bull. Torr. Bot. Club, **25**: 630, 631. 16 D. 1898.

Proposes *Pycnodon* as a substitute for the preoccupied *Kneiffia* of Fries (= *Kneiffiella* Underw., P. Henn., not of Karst.), and holds to *Boletinus* Kalchbr. as the only tenable name for the recently proposed *Boletopsis* P. Henn.

Van Wisselingh, C. Ueber den Nucleolus von *Spirogyra*. Bot. Zeitung, **56**: 195–226. *pl. 10.* 1 D. 1898.

Warburg, O. Monographie der Myristicaceen. Abhandl. Leop.-Carol. Akad. **68**: 1897.

Warnstorf, C. Beiträge zur Kenntniss exotischer und europäischer Torfmoose. Bot. Centralb. **76**: 385–390; 417–423. 1898.

Westermaier, M. Historische Bemerkungen zur Lehre von der Bedeutung der Antipoden-Zellen. Ber. deutsch. Bot. Ges. **16**: 214–216. N. 1898.

Williams, F. N. Énumération provisoire des espèces du genre *Cerastium*. Bull. Herb. Boiss. **6**: 893–904. N. 1898.

Wieler, A. Die Function der Pneumathoden und des Aërenchyms. Jahrb. wiss. Bot. **32**: 501–524. *pl. 7.* 1898.

Winkler, H. Untersuchungen über die Stärkebildung in den verschiedenartigen Chromatophoren. Jahrb. wiss. Bot. **32**: 525–556. 1898.

Wulff, T. Studien über verstopfte Spaltöffnungen. Öster. Bot. Zeitschr. **48**: 201–209; 252–258; 298–307. *pl. 8.* Je., Jl., Au. 1898.

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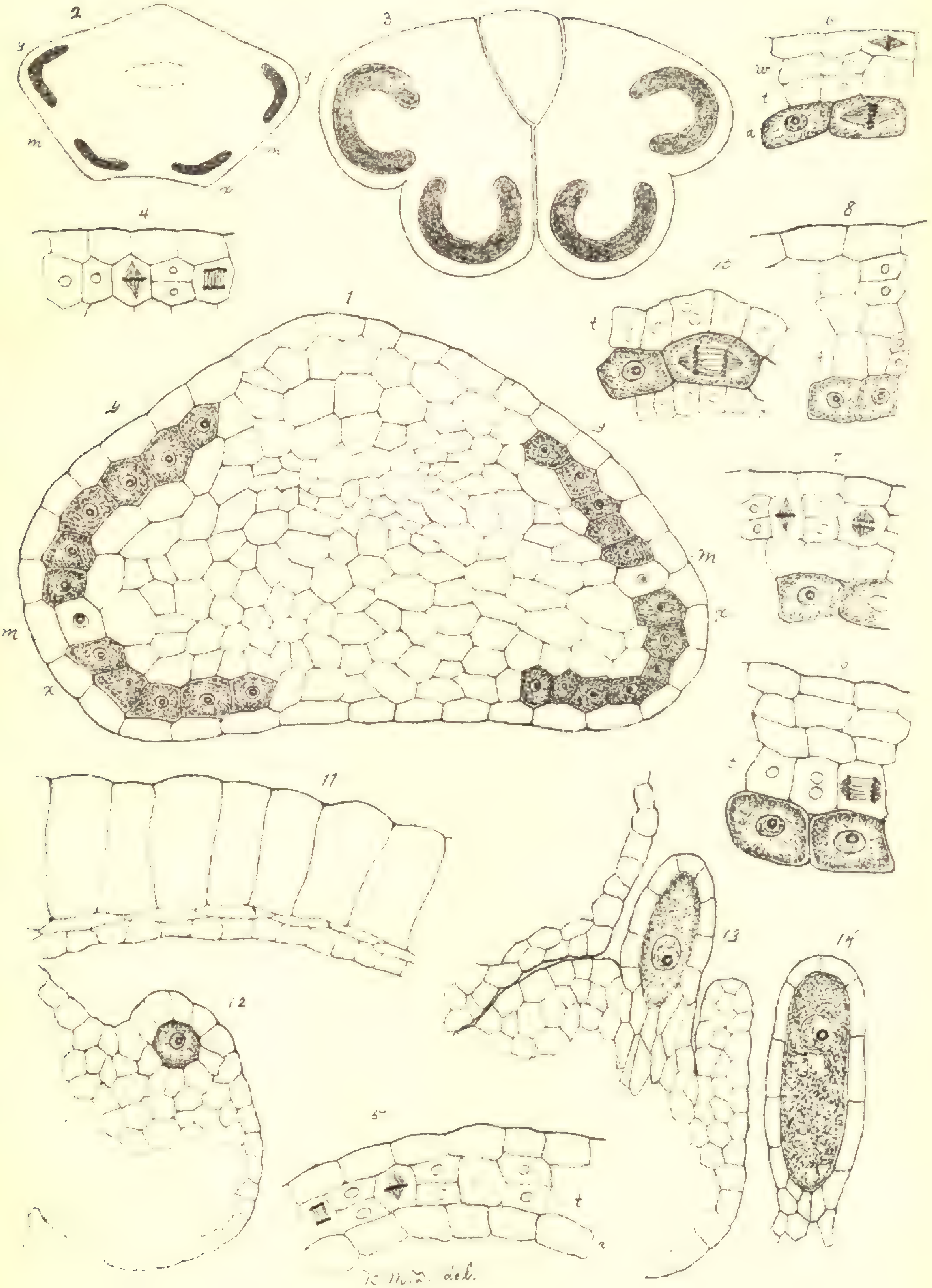
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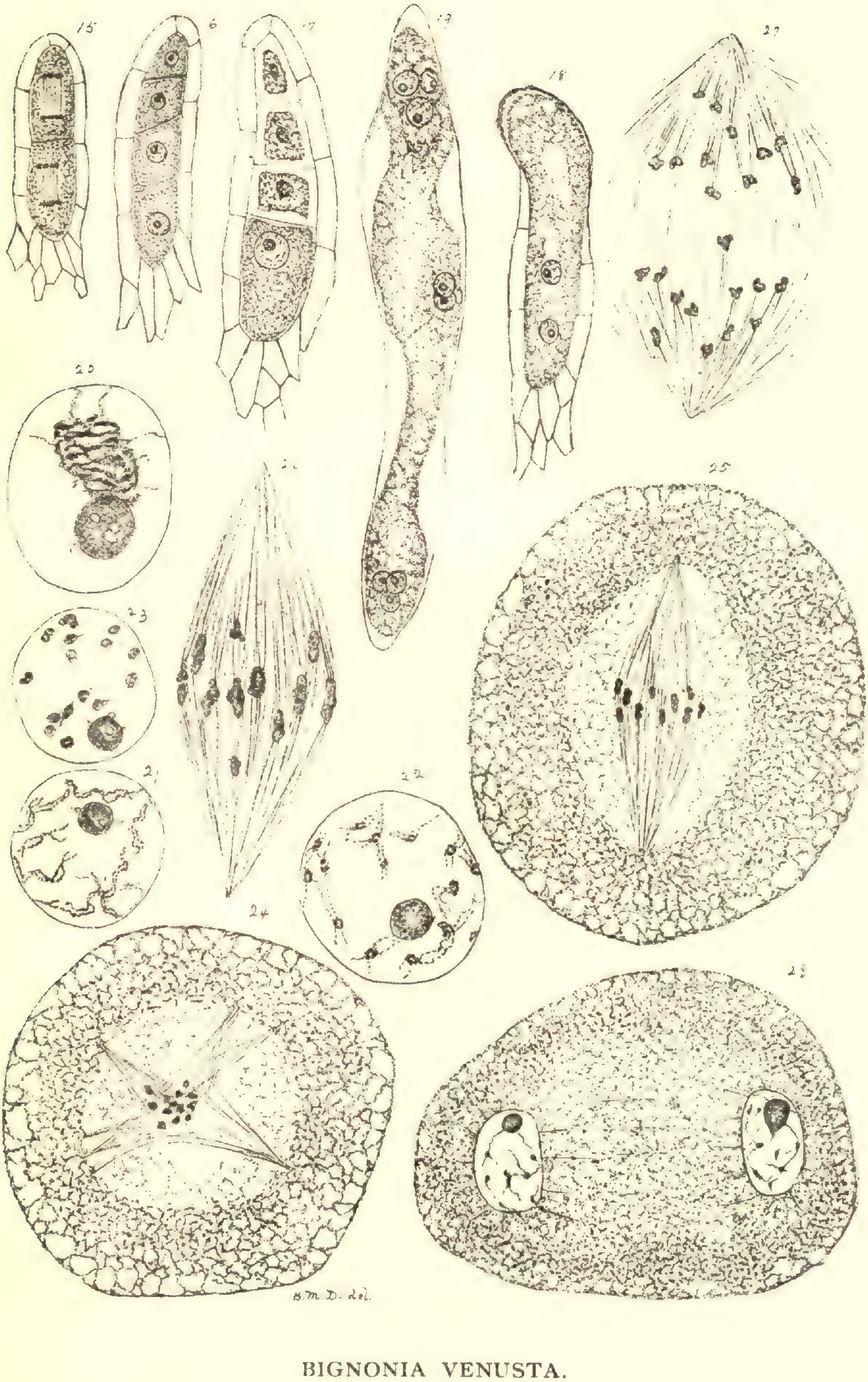
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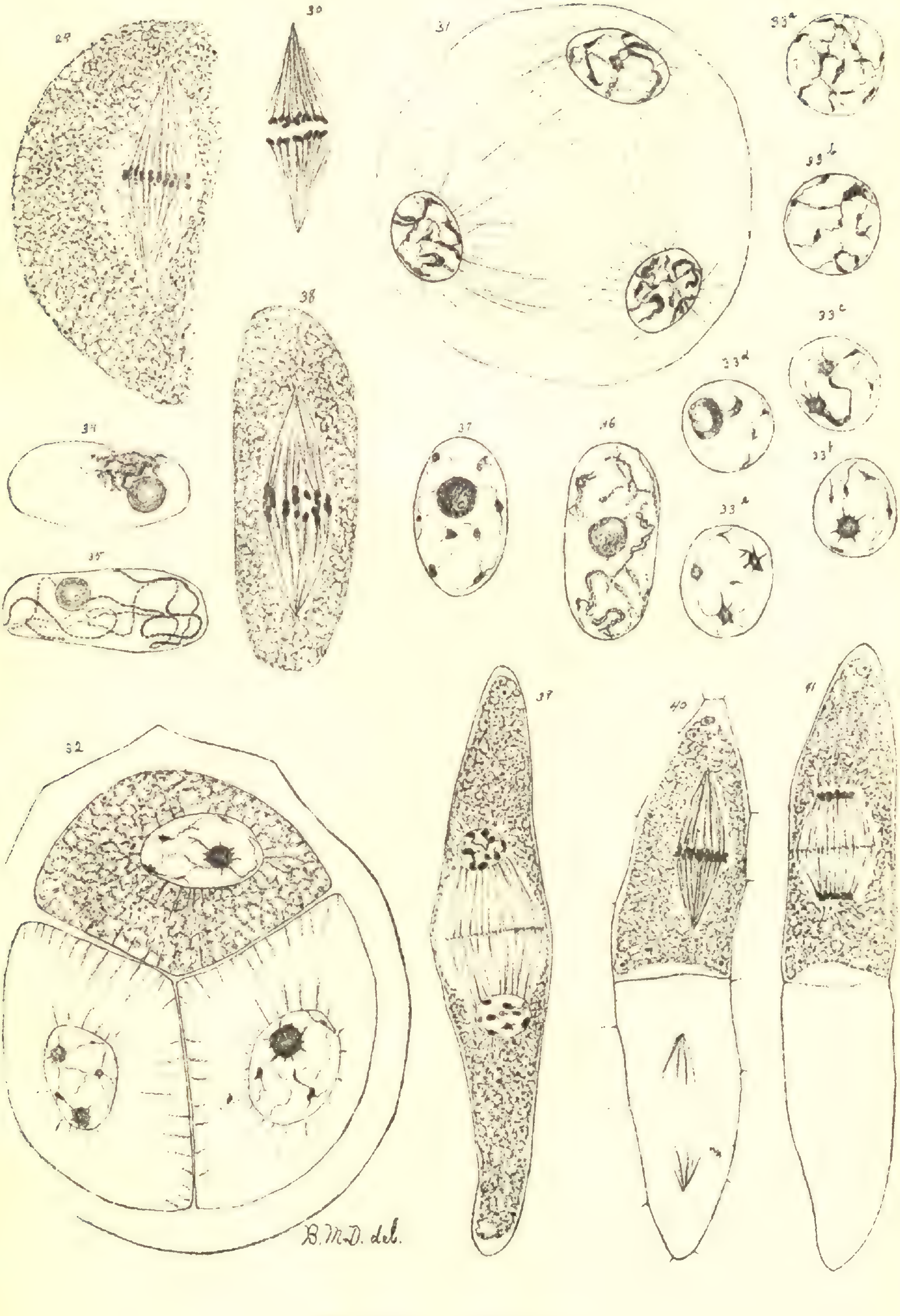
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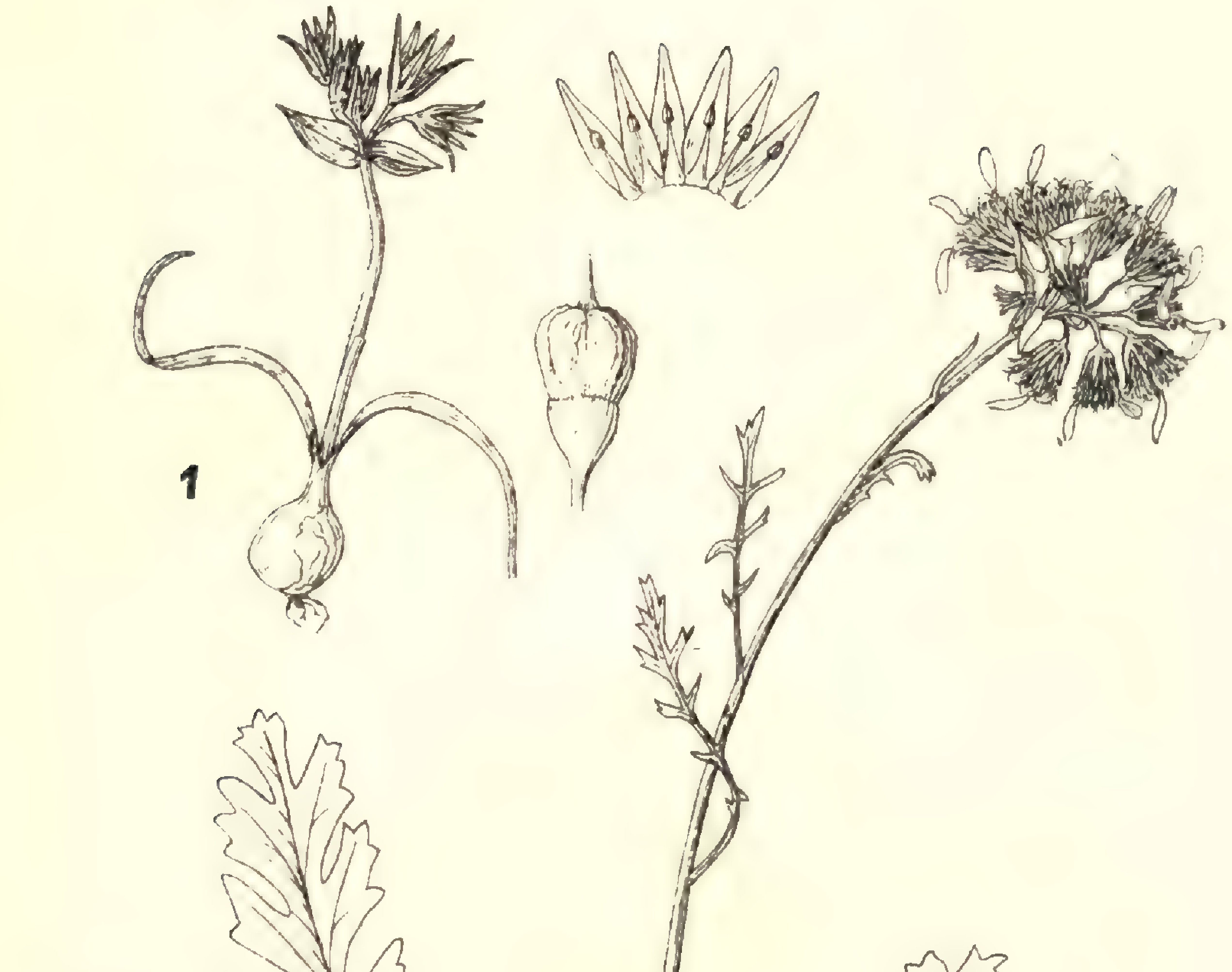

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BULLETIN

OF THE

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BULLETIN

OF THE

TORREY BOTANICAL CLUB

APRIL 1899

A Revision of the Genus Listera

BY KARL M. WIEGAND

(PLATES 356, 357)

Few genera of North American plants in which the species are distinct, and hence not difficult to understand, have been so neglected as has the genus *Listera*. During the past few years, however, several new species have been discovered, so that only one remains to be described as new in this paper. Still the known facts are so scattered and some of the species are so little understood that the present paper has been prepared with the attempt to illustrate and describe each species very fully, besides providing an analytical key for easy identification.

The genus has proved to be a very pleasant one upon which to work, owing to the distinct character of the species, and the confusion heretofore existing can be attributed only to the difficulty of recognizing types from the old descriptions. In addition to this the local and restricted distribution of all the species tended to make the solution still more difficult.

Few more interesting examples of the misinterpretation of specific types are encountered than those met with in the treatment by different authors of the western members of the *convallarioides* group. As a result of this, although numerous attempts were made to describe forms which even by the older authors were recognized as clearly distinct, until recently only one species really received a tenable name.

[Issued 12 April, 1899.]

It soon became apparent that a study must be made of the Asiatic and European representatives of the genus before definite conclusions could be reached regarding the nomenclature of the forms found in North America. These results are included here although, owing to the relatively poor facilities for the study of foreign species at the writer's command, they may not be as complete as could be desired.

From a historical standpoint the principal events may be summed up in a very few words. The two European forms were early recognized by Linnaeus, although they were referred to the genus *Ophrys.* Fifty years later *L. convallarioides,* the next species, was described by Swartz from America, and a few years afterward the same one was renamed by Chamisso and Schlechtendal. In 1840 several more species were described by Lindley but, with the exception of several synonyms, only one was American, the rest Asiatic. A Japanese species was discovered by Blume in 1858, and a Chinese species, *L. puberula,* by Maximowicz in 1883. In recent years several new species have been found in America. The first was the *L. borealis* of Morong from the northern Rocky Mountain region. Several years later Small described a new species from the Alleghany mountains; and during the past year a third and still more western species has been separated by Piper. Besides the works of Linnaeus, Willdenow and Lindley no comprehensive monographs of the genus have ever been written, and the species of North America especially have received no detailed treatment.

The genus *Listera,* although widely distributed over the temperate and arctic regions, is nevertheless a small one, and at the present time only about a dozen species are known. Very interesting in this connection is the fact that the individuals of each species are always rare or local, seeming to seek only the most secluded nooks in our damp mossy woods and largest peat bogs.

The most widely distributed of all the species, and at the same time the smallest flowered, is *L. cordata.* It is, moreover, the only one found throughout the temperate zone. First described by Linnaeus under the name *Ophrys,* it was later one of the species upon which Brown founded the genus *Listera.* The characters of the plants are so distinct and constant that but little confusion has arisen in regard to the type, although there are a few cases of error, the most notable of which were those of Bigelow, who mistook this species for *L. convallarioides*, and of Nuttall in confusing it with *L. australis* then unrecognized. As to the type of this species there can be little doubt.

Another plant closely related to the above is the *L. australis* of the Southern States, which is distinguished principally by the absence of lateral teeth at the base of the lip. By the earlier botanists it was confused with the more northern *L. cordata*, but was early recognized as distinct by Lindley and Hooker. Previously Elliott had confused it with *L. convallarioides*, for which reason Hooker ventured the manuscript name *L. Elliotti*. There is in this species a typical case of the extreme local distribution of many orchids. The main distribution of *L. australis* is along the southern Atlantic coast northward to the Pennsylvania line, but in 1877 Wibbe * found it in a swamp near the eastern end of Lake Ontario. Since that time it has been found in several other deep sphagnous swamps in the same region. Between these swamps and the next station toward the south lie at least two hundred and fifty miles. The relation of this species to the Oswego flora has been discussed by Professor Rowlee † and needs no further mention here. Dr. Mellichamp ‡ thinks that in some cases, at least, *L. australis* may be semi-parasitic on the rootstocks of *Osmunda cinnamomea*. The writer has not had an opportunity to investigate this point.

The *Listera ovata* of Europe is of the *australis* type although quite different in general appearance, and is the largest of all existing species of *Listera*. It was recognized by Linneus but under the generic name *Ophrys*, and later, together with *L. cordata*, formed the basis of Brown's characterization of the genus *Listera*.

The one species of all others which has led to so much confusion is the *Epipactis convallarioides* of Swartz. It is, indeed, true that the original description is quite brief and does not seem to accurately describe any known American plant. There is one, however, with which it agrees better than with the others, and which from the locality must have been the one found by Torner "*e terra nova Am. Sept.*" The leaves are, however, rarely "cordate-subrotund, acute," but the description of the labellum is sufficiently accurate. This species is more widely distributed through North America than others of this group, and is the type of the *L. convallarioides* of most American botanists. As has been shown by Morong* and Holzinger‡, Nuttall's name so often cited for this species is merely a *nomen nudum*, no description being given; and since the first characterization under *Listera* was by Torrey, it follows that the latter should be cited as the author of the name. As will be seen from the synonomy given later in this paper *L. convallarioides* has been by many authors confused with *L. cordata* and *L. australis.* Next to *L. cordata* this species has the widest distribution.

---

* Bull. Torr. Bot. Club, **6**: 192. 1877.

† American Naturalist, **31**: 798. 1898.

‡ Bull. Torr. Bot. Club, **8**: 47. 1881.

The early botanists of the Northwest, however, found another form, namely, the *L. caurina* of Piper, which, by them, was taken to be the typical *L. convallarioides.* This species is well described and finely figured by Hooker in the Flora Bor. Am. where the illustration of the lip is especially characteristic. Meanwhile the true *L. convallarioides* had been obtained by Chamisso and Schlechtendal from Alaska, and named by them *L. Eschscholtziana.* That this was the case may be inferred from the description which says, leaves orbicular-ovate, ovaries pubescent, column long, lip obcordate, and there is no mention of lateral teeth; besides this there is no other species of this section found in Alaska. Lindley also seems not to have understood the Alaskan species, so that on receiving a specimen of the true *L. convallarioides* from Menzies collected on Banks Island he named it *L. Banksiana.* The original description clearly shows that only this plant could have been in mind.

The next American species was not described until 1893 when some plants collected by Miss Elizabeth Taylor in the Slave River region of Canada were recognized by Dr. Morong as distinct and named by him *L. borealis.* The range of this species has now been extended farther south.

In July, 1897, Small described *L. reniformis* from the southern Alleghanies. This very distinct species had hitherto been entirely overlooked, but unfortunately the name had already been used by

---

‡ Mem. Torr. Bot. Cl., 5: 124. 1894.

* Contrib. U. S. Nat. Herb. 3: 252. 1895.

Don for an orchid of India. As a substitute for this name *L. Smallii* has been employed in this paper. One of the most interesting facts encountered in the study was the discovery of this species again in eastern Asia. The two regions are as widely separated as can well be imagined, still it will be seen that we have here only an illustration, and a very fine one, of Dr. Gray's observation regarding the relation of the floras of eastern Asia and eastern North America.

The last of the series of American forms to be described was *L. caurina* which Piper recently separated from the *L. convallarioides* as found on the Pacific coast.

Another American species is here recognized for the first time, and has been given the name *L. auriculata.* Only a few specimens have been seen and these were from a very restricted locality. It may be said to be peculiar to the mountainous regions of northern New Hampshire and Maine, but is closely related to the *L. borealis* of the Rocky Mountains.

Of the five species from Eastern Asia, three were described by Lindley, viz., *L. pinetorum, L. tenuis* and *L. micrantha,* of which the second seems scarcely distinct from the first. *L. puberula* of Maximowicz is an elegant species from China and now reported also from Japan. *L. Japonica,* also of Japan, was first described by Blume and well figured in his Orchid. Japon.

Regarding the relationship and phylogeny of the species little need be said. The usual difficulty was encountered in arranging them in a lineal series, although perhaps in a more marked degree than is usual; consequently a few words of explanation may be necessary to express more clearly the writer's views. It seems probable that the unbifurcated lip and basal leaves of *L. micrantha* represent a primitive condition and perhaps a transition to other genera. Then starting with *L. micrantha* and *L. Japonica* as representing the more primitive type, two divergent lines of development may be traced. Through *L. australis* we pass to *L. ovata, L. auriculata* and *L. borealis,* all with oblong lips and without basal teeth. From forms represented by *L. cordata,* although the transition is not quite so clear, have descended through a type similar to *L. Smallii* the reniform-leaved species, *L. puberula* and *L. pinetorum;* and also from the type of *L. Smallii* along another line of development, *L. caurina* and *L. convallarioides.*

The following is a brief synopsis of the species followed by a detailed description of each. Thanks are due Dr. Robinson, of the Gray Herbarium, and Dr. Small, of Columbia University Herbarium, through whose kindness in loaning specimens this work was made possible. Professor Piper and Mr. Fernald have also very kindly loaned a large quantity of material.

Synopsis of the Species.

- Column very short (.5 mm. or less); flowers mostly small; lip not dilated above; leaves, except in one species, deltoid-ovate or reniform.
    - Lip not 2-cleft, auriculate, acute or acuminate.
        - Lip weakly bidentate at the base, scarcely longer than the sepals; leaves basal. India. 1. *L. micrantha.*
        - Lip not bidentate at the base, much longer than the sepals and very narrow; leaves near the middle of the stem. Japan. 2. *L. Japonica.*
    - Lip 2-cleft or lobed.
        - Lateral teeth strongly developed, between them a transverse fold; lip no auriculate, lobes linear; raceme glabrous. Europe, Asia, North America. 3. *L. cordata.*
        - Lateral teeth none; raceme more or less glandular; pedicels glandular; ovaries glabrous.
            - Leaves ovate; plant small (12–22 cm.); sepals minute; petals recoiled; lip auriculate, lobes almost setaceous, near the base a short transverse and longitudinal fold. Eastern United States. 4. *L. australis.*
            - Leaves oval; plant large (30–55 cm.); sepals ½ length of lip, latter not auriculate, lobes oblong, a longitudinal fold on the midrib. Europe. 5. *L. ovata.*
- Column of medium length or long (2–3 mm.); flowers larger.
    - Lip auriculate, oblong, more or less ciliate, a fold between the lateral nerves near the base, no lateral teeth, ovary and pedicels glabrous.
        - Auricles very small, clasping; leaves large (35–50 mm.), broadly ovate or oval, often acutish; plant of medium size. N. New England and Quebec. 6. *L. auriculata.*
        - Auricles large (1.5 mm.), divergent; leaves small (12–25 mm.), narrowly ovate, obtuse; plant small (7–15 cm.). Rocky Mountains. 7. *L. borealis.*
    - Lip not auriculate, dilated above.
        - Leaves oval, mostly obtuse; pedicels glandular.
            - Lip sessile, bidentate at the base, small (5 mm.), a papilla at the base of each tooth, abruptly dilated above and retuse, not ciliate; ovary glabrous. Oregon to British Columbia. 8. *L. caurina.*
            - Lip unguiculate, lateral teeth almost obsolete, larger (9 mm.), papillae none, evenly cuneate, shallowly lobed, ciliate; ovary glandular. North America, trans. cont. 9. *L. convallarioides.*
        - Leaves ovate-reniform, often acute; pedicels glabrous except in No. 11; ovaries glabrous or nearly so; lip not ciliate, and without folds.
            - Lip bidentate near the base, sessile, large (9 mm.), very much dilated and deeply lobed. Alleghany Mountains and Japan. 10. *L. Smallii.*

Lip with no basal teeth.

Stems multibracteolate below the raceme; flowers small, lip 7 mm. long, cuneate, deeply lobed, slightly dilated. China and Japan.
11. *L. puberula.*

Stems without bracts; flowers larger, lip 9 mm. long, broadly cuneate and much dilated, rather deeply lobed. India.
12. *L. pinetorum.*

1. LISTERA MICRANTHA Lindl. Journ. Linn. Soc. **1**: 176. 1857.

Leaves subrotund-ovate, radical: raceme slender, bracts much shorter than the filiform pedicels: lip ovate, cucullate, scarcely as long as the sepals, at the base furnished with a pair of auricles, the middle lobe very acute and provided on each side with a single minute tooth.

Sikkim Himalayas, alt. 10000 ft.

No specimens of this species have been studied, and the above description was adapted from the original. It seems to be a transitional form connecting this genus with *Neottia*.

2. LISTERA JAPONICA Blume, Orchid. Arch. Ind. 136. 1858.

Slender (10–20 cm. high), stem terete, erect, glabrous below, more or less glandular-pubescent above the leaves; the latter (18–22 mm. long, 15–20 mm. wide) opposite, sessile, spreading, ovate, acute or subacuminate, membranous, obsoletely nervose, glabrous: raceme lax: flowers about 6–9, small, greenish-white: pedicels slender, glandular: ovary ½ shorter: bracts minute, ovate, obtuse: perianth segments spreading, exterior lanceolate, acute, interior scarcely shorter, linear, rather obtuse: lip (three times the length of the perianth) scarcely stout, at the base cordate-sagittate, clasping the column, 3-nerved, linear-lanceolate, produced above into an elongated, declined, linear, undivided, 1-nerved limb, margins involute: column short, thick, not inclined.

Japan (Kieske). From Nippon Island, locality not indicated. Dr. Savatier (no. 3092) (according to Franchet and Savatier).

Specimens of this species not studied; the above description was adapted from the original by Blume.

3. LISTERA CORDATA (L.) R. Br. Ait. Hort. Kew. **5**: 201. 1813.

Ophrys cordata L. Sp. Pl. 946. 1753.

Epipactis cordata All. Fl. Pedem. **2**: 152. 1785. Willd. Sp. Pl. Pursh, Fl. Am. Sept.

Epipactis convallarioides Bigelow. Fl. Bost. ed. 2, 323. 1824.

Neottia cordata Rich. Mem. Mus. Paris **4**: 59. 1818.

Listera cordata Torr. Fl. N. U. S., Lindley, Gen. et Sp. Orchid. Hook. Fl. Bor. Am. Ledebour, Flora Ros. Blume, Orchid. Arch. Ind.

Stem very slender (10–18, rarely 28 cm. high), glabrous below, glandular-pubescent just above the leaves but the raceme glabrous; leaves of medium size (12–25 mm. long), inserted at the middle of the stem, broadly ovate, truncate at the base but abruptly contracted at the point of insertion, mucronate: raceme many-flowered, rather dense, very long peduncled: bracts minute (.5 mm. long), broadly ovate, obtuse: flowers very small, on short but slender (2–3 mm. long) ascending, glabrous pedicels which are several times longer than the bract but shorter than the ovary: the broadly ovate sepals and broadly oblong petals both shorter than the ovary (.5 length of the lip), spreading, obtuse: lip very small (4.5 mm. long), narrowly oblong, 3-nerved, cleft slightly over half way down into two linear acute erect lobes, no tooth in the sinus, midrib not excurrent, on each side near the base a long-spreading sulcate subulate papillose tooth (1.5 mm. long), between them a heavy fold: column very short, almost none.

Mossy woods and swamps, Labrador to New Jersey, westward to Michigan, Colorado, and California, northward to the Arctic coast; also in Greenland, Iceland, central and northern Europe and Japan (Blume).

The most widely distributed of all the species, but the specimens throughout this vast range are remarkably constant, and differ from each other only in size. A specimen in the Torrey herbarium is labeled as having been collected by Gray and Carey in the mountains of Virginia and South Carolina, July, 1841. The writer has seen no other specimen from farther south than New Jersey.

Specimens examined from Labrador (Hale), Newfoundland, Maine, New Hampshire, Vermont, New Jersey (Carey), Rhode Island, New York, Michigan, Colorado, Idaho, California, Oregon, Washington, British Columbia, Alaska, Greenland, Iceland, England, Lapland, Germany, France, Scandinavia, Switzerland.

4. LISTERA AUSTRALIS Lindley, Gen. et Sp. Orchid. 456. 1840.

Listera cordata Nutt. Gen. U. S. Pl. **2**: 191. 1818.

Listera convallarioides Ell. Sketch, **2**: 494. 1824.

Stem slender (12–22 cm. high), glabrous below, slightly red-glandular above the leaves; the latter inserted at or above the middle of the stem, small (in northern specmens 14–18 mm., in southern up to 25 mm. long), triangular-ovate, truncate or slightly cordate at the base, apiculate, primary veins three: raceme few- or many-flowered, open, rachis slender, slightly glandular: bracts minute, round-ovate, obtuse, very much shorter than the pedicels: flowers very small, on very slender glandular pedicels which equal or exceed the glabrous ovaries: petals short, oblong, recoiled: sepals round-ovate, minute, not over 1/4 the length of the lip: lip linear, long and slender (6–10 mm. long), cleft 1/3–2/3 the way down into two nearly filiform acute lobes, sinus tooth small, provided on each side at the sessile base with a small incurved auricle, an inversely T-shaped fold near the base: column very short and thick (.5 mm. long).

Shady woods and sphagnous swamps, Florida (Chapman) and Louisiana to New Jersey; also in Oswego County, N. Y., where it is confined entirely to the large peat bogs.

Some of Dr. Mellichamp's specimens show a tendency toward proliferation. Besides an increase in diameter of the stem many of the bracts are converted into leaves.

Specimens examined: Louisiana, New Orleans, Drummond (1832); South Carolina, Bluffton County, Mellichamp; North Carolina, Curtis, Garber; New York, Palermo, Oswego County, Wibbe, Sheldon, Rowlee; New York, Baldwinsville, Beauchamp, Underwood.

5. LISTERA OVATA (L.) R. Br. Ait. Hort. Kew. **5**: 201. 1813.

Ophrys ovata L. Sp. Pl. 946. 1753.

Epipactis ovata Crantz. Stirp. Austr. ed. II., 473. 1769. Willd. Sp. Pl. **4**: 87. 1805.

Neottia latifolia Rich. Mem. Mus. Paris, **4**: 59. 1818.

Plant very large and stout (30–55 cm. high), glabrous below the leaves, densely pubescent above, with loose basal sheaths and several bracts below the raceme; leaves borne below the middle of the stem, very large (7–12 cm. long), elliptic-oval, mucronate, many-nerved: raceme (15 cm. long), many-flowered, slender, but rather dense, very long peduncled: rachis pubescent: bracts of medium length, ovate, acuminate: flowers large, on short slightly glandular pedicels which equal the glabrous ovaries, and are scarcely longer than the bract: the ovate obtuse sepals and broadly linear petals both as long as the ovary (1/2 length of lip) erect or spreading: lip large (10 mm. long), narrowly oblong-cuneate, sessile, without auricles or lateral teeth, cleft 1/3–1/2 way down by a narrow sinus, lobes narrowly oblong obtuse, not ciliate; sinus tooth prominent; a longitudinal fold along the midrib: column very short and stout (1 mm. long).

Damp woods; central and northern Europe.

The largest of all species of *Listera*, and to a certain extent a transition to the group with longer columns.

Specimens examined: Scandinavia, Ahlberg; Alps, Reverchon; France, Germany.

6. **Listera auriculata** sp. nov.

Stem slender (12–18 cm. high), glabrous below, glandular-pubescent above the leaves; bracts below the raceme absent: leaves large (35–50 mm. long), elliptic-oval or elliptic-ovate, acutish (rarely obtuse), inserted above the middle of the stem: raceme many-flowered but not dense: rachis pubescent: bracts not large, oblong-lanceolate, often obtuse, glabrous: flowers of medium size on stoutish glabrous pedicels which are mostly shorter than the glabrous ovaries, and scarcely exceed the bracts: sepals lance-ovate: petals oblong-linear, large (½ length of lip), longer than the ovary, spreading, mostly obtuse: lip of medium size (6–8 mm. long), slightly ciliate, oblong, not dilated above, cleft ¼–⅓ the way down by a narrow sinus, not contracted at the base and without projecting teeth, more or less auriculate, the auricles incurved-clasping, a fold between the lateral veins near the base: column rather stout, of medium length (2.5 mm. long).

Cedar swamps and mossy banks, Quebec, New Hampshire and Maine.

Specimens examined: Quebec, Miss Percival (Torr. Herb.). Notre Dame du Lac, Quebec, Northrop, 1889 (Columb. Herb.). White Mountains, N. H., Mann (Cornell Herb.). Maine, Fort Kent, Furbish; Jerusalem, Fernald; Woodstock, Parlin.

7. LISTERA BOREALIS Morong, Bull. Torr. Bot. Club, **20**: 31. 1893.

Plant small but not slender (7–15 cm. high), pubescent above the leaves, no bracts below the raceme: leaves very small (12–25 mm. long), elliptic-ovate, abruptly contracted at the base, obtuse at the apex and not mucronate, borne above the middle of the stem but one inserted slightly above the other: raceme few-flowered, open: rachis glandular-pubescent: bracts small, oblong, obtuse: flowers of medium size, on short rather stout glabrous pedicels, which equal the glabrous ovaries (3.5 mm. long), but are several times the length of the bract: the lanceolate sepals and oblong-linear petals, both large, obtuse (¾ length of the lip), longer than the ovary, spreading: lip short (7 mm. long), broadly oblong, deeply retuse at the apex, the sinus open, its tooth unusually large, lobes very obtuse but scarcely dilated, base sessile, expanded on each side into a large oblong divergent auricle (the latter 1½ mm. long, 1¼ mm. wide), a fold extending between the lateral veins near the base, lip strongly ciliate and cellular-papillose toward the apex: column long (3 mm.), and rather stout, arcuate.

The long white hairs mentioned in the original description as borne in the inflorescence, although abundant on the type specimen, are almost entirely wanting on the other specimens, which suggests that they may be foreign bodies.

Rocky Mountains of Colorado, and northward to the Slave River British America.

Specimens examined: Colorado, Sawatch Range ("alpine") Brandegee. Rocky Mts., Drummond. Ft. Smith, Slave River, N. W. Ter., Miss E. Taylor (Columbia Herb., type). Ft. Simpson, Brit. Am. (Columbia Herb.).

8. LISTERA CAURINA Piper, Erythea, **6**: 32. 1898.

Listera convallarioides Hooker Fl. Bor. Am. *pl. 205.* 1840.

Stem slender (12–30 cm. high), glabrous below, densely glandular-pubescent above the leaves, rarely a bract below the raceme, basal sheaths loose; leaves rather large (35–70 mm. long), oval to elliptic-ovate, thin, slightly apiculate or often acute, borne near the middle of the stem, bright green: raceme many-flowered, open: rachis pubescent: bracts 2–5 mm. long, rhombic-ovate, acuminate, often slightly glandular, the lower sometimes two-flowered and bifurcate: flowers small, the long slender glandular pedicels (4–6 mm. long) longer than the bracts and exceeding the ovaries; the latter glabrous: sepals and petals both lanceolate or linear-lanceolate, acutish, ⅔ the length of the lip, slightly longer than the ovary, spreading: lip rather small (5 mm. long), slightly declined, narrowly oblong, abruptly dilated and rounded above, not ciliate, retuse, mucron in the sinus blunt, provided at the sessile base with a very slender, almost filiform, ascending glabrous nerveless tooth on each side (1 mm. long), a papilla at the base of each tooth: column relatively short, not stout (1.5 mm. long).

Damp mossy woods, Oregon and Idaho to British Columbia. (Hooker). Occasionally one or two bracts are borne below the raceme.

Specimens examined: Oregon, near Mt. Hood, Howell (1875);

Spacious Bay, Gorman. Washington, Between Pend d' Oreille and Kootenai Rivers, Lyall (1861); Skamania Co., Suksdorf, no. 2326 (1894); Chehalis Co., Lamb, no. 129 (1897); Tacoma, Flett, no. 145 (1895); Cascade Mts., Henderson. Idaho, Latah Co., Piper.

9. LISTERA CONVALLARIOIDES (Swartz) Torr. Fl. N. U. S. 320. 1826.

Epipactis convallarioides Swartz, Vet. Acad. Handl. Stock. **21**: 232. 1800. Willd. Sp. Pl. Pursh, Fl. Am. Sept.

Listera Eschscholtziana Cham. & Schl. Linnaea, **3**: 33. 1828.

Listera Banksiana Lindl. Gen. et Sp. Orchid. 455. 1840.

Stem slender (12–20 cm. high), glabrous below, densely glandular-pubescent above the leaves, rarely with a bract below the raceme; leaves borne above the middle of the stem, rather large (30–50 mm. long), broadly oval, obtuse, very rarely apiculate, rounded at the base: raceme many-flowered, open: rachis densely glandular: bracts large (3–5 mm. long), rhombic-ovate, acute, often slightly glandular: flowers large, on very slender but rather short glandular pedicels which scarcely exceed the bracts and are slightly longer than the glandular ovary: the oblong-lanceolate sepals and narrowly linear petals both large (4.5–5 mm. long), longer than the ovary, reflexed, acutish: lip large (9 mm. long), narrowly cuneate, retuse, lobes rounded, minutely ciliate, ¼ distance from the base provided with a very short triangular tooth on each side, and below these contracted into a stalk-like portion, without folds on the upper surface: column long and slender (3 mm. long), nearly straight.

In moist woods, Nova Scotia to Vermont, and from Michigan to California, northward to Alaska.

The Maine specimens have more elliptic leaves which are often acute.

Specimens examined: Nova Scotia, Macoun (1883) Nutt Mts.; New Brunswick, Fowler (1870), Bass River; Quebec, Allen (1881); Maine, Fernald (1893), nos. 102, etc.; New Hampshire, Oakes, Hitchcock; Vermont, Carey, Pringle, Eggleston; Michigan, Robbins, no. 154, Porter, Mann, Whiting, Atkinson; Wyoming, Nelson, no. 1694 (1895); Nevada, Watson, no. 1157 (1865); California, Plumas Co., Bolander, Ebbet Pass, Brewer, San Joaquin Riv. Muir, Lemmon; Oregon, Union, Cusick (1875), Howell, no. 724 (1887), Galton Mts., Lyall (1861); Washington, Piper, Lamb; Idaho, Latah Co., Sandberg, no. 458, Quartzby, Mulford; Alaska, Gamisse; Behring Island, Macoun, no. 231 (1891).

10. **Listera Smallii** nom. nov.

Listera reniformis Small, Bull. Torr. Bot. Club, **24**: 334. 1897. Not of Don. Prod. Fl. Nep. 28. 1825.

Stem slender (15–30 cm. high), glandular-pubescent above the leaves, usually with one or two ovate-subulate bracts below the raceme; leaves borne at or below the middle of the stem, rather small (15–25 mm. long), ovate-reniform, mucronate, often apiculate: raceme few-flowered, open: rachis glandular: bracts small, narrowly rhombic-ovate, acute, glabrous: flowers large, on very slender glabrous pedicels which equal or exceed the glabrous ovary, twice as long as the bract: sepals lanceolate: petals lance-linear, acutish, longer than the ovary (⅓ length of lip), spreading or reflexed: lip large (9 mm. long), not ciliate, broadly obovate and much dilated at the rounded apex, cleft ⅓–½ way down by an open sinus, provided with a large and broad (1 mm. long) oblong or obovate, obtuse, 1-nerved, glabrous tooth on each side above the sessile base, many-nerved, folds wanting: column rather short (1.5 mm. long) and thick.

Damp woods, mountains of southern Pennsylvania, Maryland, Virginia, and North Carolina, also in Japan and the Amur region of Eastern Asia.

This is the American representative of the Asiatic group of species having reniform leaves. The specimens from Asia and Japan differ from the type in having much smaller flowers with the lip only ⅓ as long as the sepals, and may possibly represent a distinct species. When dissected the outline of the lip is almost exactly the same in both cases.

Specimens examined: Pennsylvania, Porter; Virginia and North Carolina, Gray and Carey (1841); Roan Mountains, Gray (1879); North Carolina, LeRoy and Ruger (1872), Curtiss, Beardslee and Kofoid (1891), Blowing Rock, Small and Heller, no. 251 (1891); Maryland, Gray (1843); Virginia, Britton and Vail (1892); Nixo, Japan, Maximowicz (1864), Gray Herb. Distributed under the name *L. Japonica* Bl.; Amur Region, Maximowicz, labeled *L. Eschscholtziana* Cham. Gray Herb.

11. **LISTERA PUBERULA** Maxim. Bull. Acad. St. Petersb. **29**: 204. 1883.

Plant very slender (12–20 cm. high), glandular-pubescent above the leaves; the latter inserted much below the middle of the stem, rather small (15–25 mm. long), deltoid-ovate, truncate or slightly cordate at the base, apex rounded or barely acute, the three primary veins strong: raceme few-flowered, open, on a very long (7–10 cm.) many-bracted peduncle: rachis very slender, pubescent: bracts rather small, subulate, acuminate: flowers very small, on slender glandular pedicels, the latter longer than the glabrous ovary and twice the length of the bract: petals and sepals linear, mostly obtuse, 1/3 the length of the lip, erect-spreading: lip small (7 mm. long), narrowly and regularly cuneate, without auricles or teeth toward the base, cleft 1/3 the way down, sinus narrow, lobes oblong, obtuse, not ciliate: column of medium length (1.5 mm,) stout, nearly straight.

In mossy woods, Province Kansu, western China, Pszewalski 1880 (according to Maximowicz); Nanokawa, Tosa, Japan (Watanabe, 1889).

The above description was drawn from the Japanese specimen.

12. **LISTERA PINETORUM** Lindl. Journ. Linn. Soc. **1**: 175. 1857.

Plant rather stout (10–15 mm. long), glandular-pubescent above the leaves; the latter of medium size (15 mm. long), inserted above the middle of the stem, broadly ovate, obtuse, acute, or even acuminate, truncate, the base many-nerved: raceme very short (3–6 cm. long) and few-flowered: rachis stout, glandular: bracts large (7–12 mm. long), lanceolate, acute, appressed: flowers very large, nearly sessile: ovary and pedicel nearly glabrous: sepals ovate-lanceolate, sulcate: petals linear, both acutish, spreading, one half as long as the lip: lip large (9 mm. long), obovate-cuneate, tapering to a narrow base, thickened along the midrib but with no distinct fold, without auricles or lateral teeth, cleft one third the way down by a very narrow sinus, lobes broad and rounded, not ciliate: column long (3 mm.), rather slender, arcuate.

In pine woods, Sikkim Himalayas, alt. 10000–12000 ft. (Hooker and Thomson).

The above description was drawn from a portion of the original material.

Listera tenuis Lindl. Jour. Linn. Soc. **1**: 176, 1857, from the original description seems not to be distinct from *L. pinetorum.*

The specimen labeled this in the Gray herbarium and collected in Sikkim by Hooker and Thomson is identical with the one labeled *L. pinetorum*.

Explanation of Plates 356, 357

Similar parts are drawn to the same scale, in all cases; *a*, entire plant; *b*, flower, side view; *c*, labellum as seen from above; *d*, column, side view.

1. *Listera puberula* Maxim.
2. " *auriculata* sp. nov.
3. " *pinetorum* Lindl.
4. " *ovata* (L.) R. Br.
5. " *borealis* Morong.
6. *Listera convallarioides* (Swartz) Torr.
7. " *Smallii* nom. nov.
8. " *caurina* Piper.
9. " *cordata* (L.) R. Br.
10. " *australis* Lindl.

CORNELL UNIVERSITY.

The Morphology of the Genus Viola*

By Henry Kraemer

A few years ago the author undertook, at the suggestion of Professor Arthur Meyer, Marburg, Germany, the study of the two forms of *Viola tricolor* L., which are rather common in certain parts of Germany, with the view of this study forming the basis of a scientific monograph on the genus *Viola*. The great necessity for such a work is expressed in Engler and Prantl's "Die natürlichen Pflanzenfamilien" as a "dringende Notwendigkeit."

The writer has examined and compared certain parts of about 30 species of this genus, most of which are found in the United States. Special attention has been devoted to the character of style and stigma, stamen, hairs upon stigma, stamens and petals, shape and size of pollen grains and bracts with mucilage-secreting hairs. The results of the study thus far made are given at this time with the reservation to change certain details as further study may suggest, since there is so much chaos in the genus that one hesitates to make positive statements with regard to the characters of the different species.

Characters of the Genus.

The genus is characterized, so far as the writer's studies go, by herbaceous, annual, biennial or perennial plants, which are either caulescent or acaulescent. Stolons or rhizome-like products may be present or absent. The arrangement of the leaves in the acaulescent forms is basal, whereas in the caulescent, they are alternate, the disposition above the cotyledons varying from $\frac{1}{4}$ and $\frac{1}{3}$ to $\frac{2}{5}$. The leaves, apparently in all cases, consist of lamina, petiole and stipulae. The lamina, stipulae, bracts and calyx all appear to possess characteristic mucilage-secreting hairs at the apex and at the apices of the divisions.† On the stem, lamina, stipulae, bracts and all parts of the flower excepting the stamens, characteristic sub-epidermal mucilage cells are to be found.

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* Read at the annual meeting of the Society for Plant Morphology and Physiology, Dec. 28, 1898.

† Already described in Inaugural-Dissertation on *Viola tricolor* L. Marburg, 1897.

The flowers are solitary and arise in the axils of the leaves, beginning normally with about the sixth node. The peduncle varies in length and bears at the summit the flower in a partly resupinate position. The length of peduncle increases from the development of the flower bud to the maturing of the fruit. The position of the flowers varies from an erect (in the bud) to a partly resupinate (in the full grown flower) and finally in the maturing of the fruit resumes the erect position. On the peduncle are borne the bracts which vary in size and in position to some extent on the same plant.

The flower consists of five sepals, five petals, five stamens and a one-celled ovary with three parietal placentae. There is an irregularity in form of stamens and petals and the flower is median zygomorphous. The sepals are green, equal and are provided at the base with a slight auriculate appendage. They are united with the ovary for about a third of the length of the latter and are persistent with the mature fruit.

The petals are of three kinds in shape, two above alike, two on each side alike and one that has a spur or sac-like appendage at the base. The latter petal is situated on the under side of the flower in its more or less resupinate position and is adnate with two of the sepals. The side petals are erect at the lower portion and bent so as to form with the spurred petal the characteristic short tube of the corolla. The side and spurred petals may be provided on the upper surface with papillae or hairs or both but are in some cases free from the same. The uppermost petals are similar in shape, nearly erect and resemble the upper portion of the side petals. Hairs are wanting but papillae are sometimes present.

In color the petals vary from a white (which may be streaked with purplish or brownish colored veins) to pale blue with darker colored veins, or deep blue or bluish-yellow or yellow color.

The petals and stamens are inserted on the calyx. The stamens alternate with the petals and lie close upon the ovary. They are connivent and are all provided at the apex with a yellowish arrow-shaped appendage. The two on the side near the spurred or sac-like petal possess in addition a sac-like or spurred nectar secreting appendage which projects into the petal. The anther cells are introrse and possess a characteristic collenchymatic thickened cell in the mesophyll. After fertilization and the development of the fruit the slight filament attaching the stamens to the calyx is ruptured.

The ovary is half superior, about 3 to 4 mm. long and possesses three parietal placentae on each of which 15 to 24 ovules are borne which are arranged in about four transverse rows. The odd one of the three carpels lies between the two spurred stamens. In some cases as in *V. odorata* and *V. scabriuscula* the ovary is covered with hairs.

The style is hollow, is either bent or straight, of either nearly uniform thickness or becoming gradually of greater diameter towards the apex. It is persistent and scarcely projects above the appendages of the stamens. The stigma is more or less head-like and hollow, in some cases of scarcely greater diameter than the style. In most cases it is, however, much larger and provided with a beak-like extension which projects in the direction of the petals and stamens, that have a sac-like or spurred appendage, and possesses at the apex an opening for the entrance of the pollen grains. There is also in some cases a posterior projection which may be quite prominent as in *V. palustris* and *V. primulaefolia.*

The fruit is a tricarpellary capsule discharging its seeds in dry weather by a sudden dehiscence.

The seeds are elliptical in shape (17 × 9 mm.) and when ripe of a yellowish-brown color; they possess a slight caruncle.

STIGMA IN DETAIL.

In the following species slight papillae are found on the outer surface of the stigma: *V. arenaria, V. blanda, V. lanceolata, V. odorata, V. ovata, V. palustris, V. pedata, V. primulaefolia, V. obliqua, V. palmata, V. rostrata, V. rotundifolia, V. sagittata, V. Selkirkii, V. sororia and V. striata.*

Both papillae and hairs are present on the outer surface of the stigma in the following: *V. Canadensis, V. delphinifolia, V. heterophylla, V. hastata, V. Labradorica, V. lutea, V. Nuttallii, V. pubescens, V. scabriuscula, V. striata, V. tricolor* and its varieties and *V. tripartita.*

A more or less developed lip-like appendage at the opening of the stigma is found in *V. heterophylla*, *V. lutea* and *V. tricolor* and its varieties.

STYLE IN DETAIL.

The length of style varies from 1.8 mm. (in *V. lutea*) to 3.9 mm. (in *V. pedata*). In the following species there is a decided bend in the style near the base: *V. Canadensis*, *V. hastata*, *V. lutea*, *V. heterophylla*, *V. rotundifolia*, *V. Nuttallii*, *V. scabriuscula*, *V. tricolor* and its varieties and *V. tripartita*. The following possess a slight bend in style: *V. arenaria*, *V. blanda*, *V. palustris*, *V. renifolia*, *V. delphinifolia*, *V. palmata*, *V. obliqua* and *V. odorata*. In the following species the style is nearly straight: *V. pedata*, *V. sororia*, *V. striata*, *V. Selkirkii*, *V. Labradorica*, *V. rostrata*, *V. ovata*, *V. lanceolata*, *V. primulaefolia* and *V. sagittata*. The shape of style and stigma of the species examined is given in the figures.

STAMEN IN DETAIL.

The length of sac-like or spurred nectar-secreting appendage is in the following species from 0.9 mm. to 1.3 mm. in size and less than anther cells: *V. lanceolata*, *V. palustris*, *V. renifolia*, *V. blanda* and *V. primulaefolia*.

In the following species the spur is from 1.8 to 2.6 mm. in width and same length as anther cells: *V. hastata*, *V. Nuttallii*, *V. Canadensis*, *V. rotundifolia*, *V. scabriuscula*, *V. pubescens* and *V. tripartita*.

In the following species the spur extends below the anther to the distance in mm. indicated in the figures in parenthesis: *V. tricolor arvensis* (1.5), *V. ovata* (1.5), *V. pedata* (1.8), *V. tricolor vulgaris* (2.0), *V. palmata* (2.3), *V. arenaria* (2.6), *V. heterophylla* (2.6), *V. Labradorica* (2.6), *V. sororia* (2.6), *V. striata* (2.6), *V. lutea* (2.8), *V. obliqua* (2.8), *V. sagittata* (2.8), *V. delphinifolia* (3.0), *V. Selkirkii* (3.1), *V. odorata* (3.6), *V. rostrata* (9.3).

In the following species papillae are not found on anther cells but only upon the nectar-secreting spur; *V. arenaria*, *V. Canadensis*, *V. lanceolata*, *V. odorata*. In addition to the presence of papillae on the spur the following possess long (100 μ) hairs with a slight crook at the end on anther cells: *V. heterophylla*, *V. lutea*, and *V. tricolor* and its varieties. The remaining possess only papillae in both spur and the anther cells.

The pollen grains when dry are of a narrow elliptical shape and when examined in liquids are broadly elliptical or somewhat spherical. When viewed in section they are 4- or 5-sided. In the following species they are about 70 μ in diameter: *V. heterophylla, V. lutea* and *V. tricolor* and its varieties. In the remaining species examined they vary from 30 to 42 μ in diameter.

PETALS IN DETAIL.

Among writers there is considerable variance as to the presence or absence of hairs on the petals of the different species of this genus. This may be explained in part owing to the fact that at the portion of the petals where hairs are usually found (viz. at the opening of the corolla tube) large masses of germinating pollen grains, with their tubes matted together, are frequently seen and these might be easily mistaken for hairs without closer study. Hairs only occur upon the upper surface of the side and spurred petals and vary in form and size from minute papillae to long straight or corkscrew-like forms. On the petal with a sac-like or spur appendage no hairs or papillae are found in the following species: *V. striata, V. arenaria, V. blanda, V. hastata* and *V. Labradorica.* In the following species straight hairs varying from 3.5 to 5.2 mm. are found: *V. delphinifolia, V. obliqua* and *V. ovata.* In the following species characteristic corkscrew-shaped hairs, which vary in size from 2.5 to 5.2 mm., occur: *V. heterophylla, V. lutea,* and *V. tricolor* and its varieties. In the remaining species examined papillae are present.

On the side petals no hairs or papillae are found in *V. blanda.* In the following species papillae only are to be found: *V. lanceolata, V. palustris, V. pedata, V. primulaefolia, V. renifolia, V. rostrata,* and *V. Selkirkii.* In a few species the papillae appear to be either wanting or minute, hairs being present: *V. arenaria, V. Labradorica, V. odorata, V. ovata* and *V. sororia.* In the remaining species examined both papillae and hairs are to be found.

MUCILAGE CELLS.

The sub-epidermal mucilage cells have been shown by the author (*loc. cit.*) to be characteristic for the genus *Viola,* and possibly for some other genera of the group Violeae of the

Violaceae. This would distinguish the group from the Rinoreae and possibly Papayroleae, although of the latter no specimens have been examined.

The peculiarity in shape of these mucilage cells was considered by the author for some time as having in themselves a diagnostic specific value. But in only a few instances is this the case and further study is necessary here.

A CONSIDERATION OF SOME PROMINENT CHARACTERS OF THE GENUS.

For the full comprehension of the significance of the various parts of the plants of a genus and the value to be given to their similarity or dissimilarity in structure, considerable study must necessarily be given to many plants from rather widely separated areas.

1. As we look upon this genus we find that whether we are dealing with annuals, biennials or perennials, climatic influences play an important part, as Kerner has shown that where annuals do not have sufficient warmth to produce seeds (as in Alpine regions) the plants are transformed into perennials.

2. As to whether plants are caulescent or acaulescent the results of Kerner, as well as the author's own observations, would lead us to believe that they are dependent largely also on climatic conditions. Kerner found that the number and length of internodes that plants produced are dependent on the climate in which they are growing. Some plants of *Viola tricolor* L., var. *vulgaris* Koch which were gathered in October, 1895, on the top of an exposed mountain near the Struth Forest in Germany, were exceedingly dwarfed in every particular and resembled but slightly caulescent plants. On planting them in garden soil they become a foot high and in every way showed a stronger development.

3. Some species produce an addition to the spring flowers, cleistogamic flowers. It is not unusual for some plants in other orders to produce in the fall or late summer months cleistogamic flowers. These are produced when the grass and various other plants have grown up and the spring flowers would very likely, at this time, be passed unnoticed by the insects which might assist in their fertilization. This would correspond to the investigations of

Kerner upon *V. sepincola.* He found that this plant produced cleistogamic flowers only when growing in shaded woods and that the same plants when exposed to the sunshine produced beautiful blue and scented blossoms. This is possibly due to the fact, as he suggests, that when exposed to the sun bees will visit the flowers which they would not do if the plants were growing in dark woods.

4. In some plants, as in *V. hastata,* the rhizomes are frequently light-colored, approaching white. It would seem, further, according to Kerner, that such rhizomes were produced in these plants only when growing in dark recesses and well covered with soil, for if the plants are exposed to greater light these rhizomes become violet-colored. This would indicate that color of rhizome, like the previous characters, means simply a characteristic that is dependent upon situation or habitat.

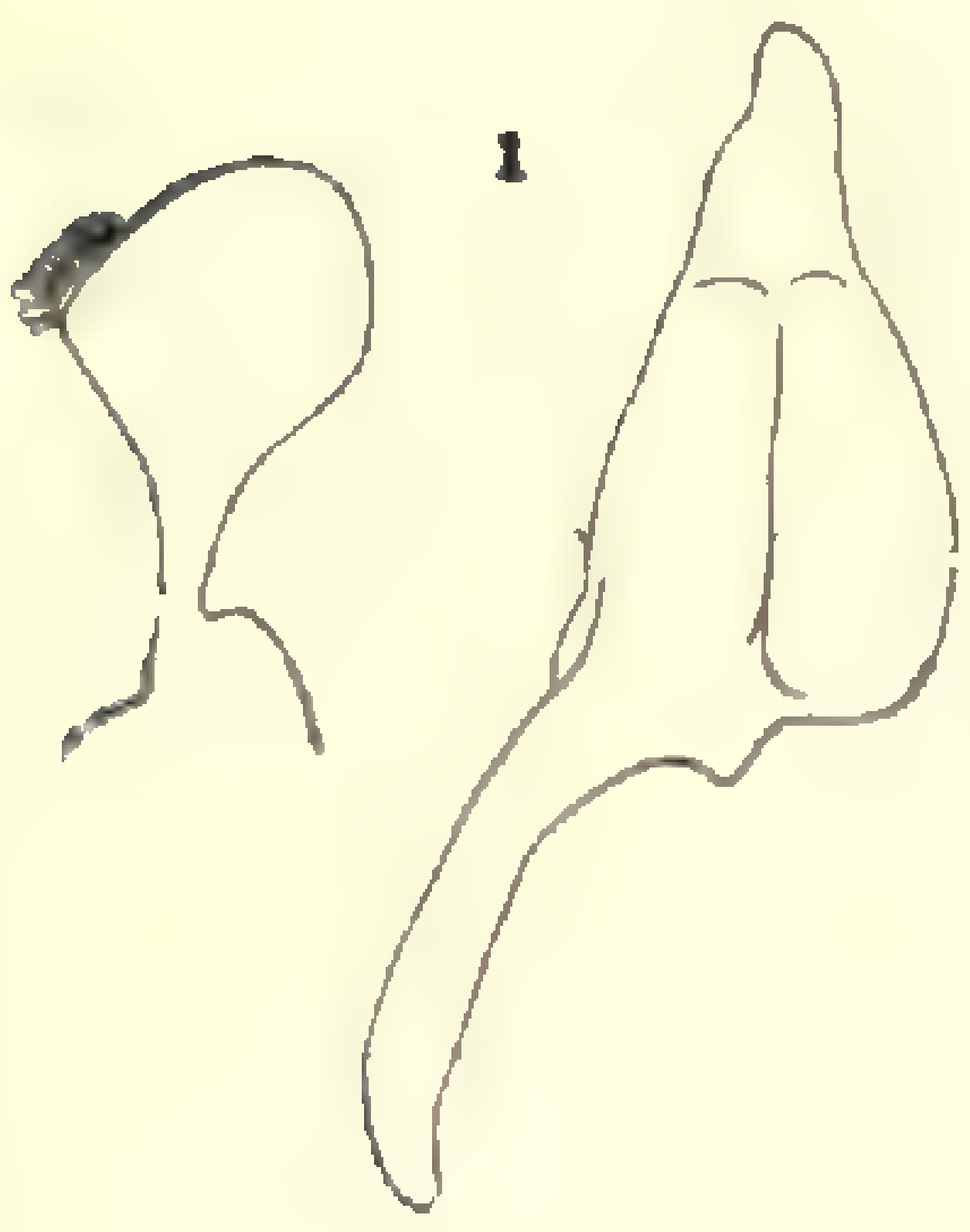
5. What value shall we place upon colors in flowers? Kerner has shown that when *V. calcarata* grows in the meadows of the western Central Alps that the flowers are of a blue color, whereas when growing in the Tyrolese Vintschigan they are yellow and when found on plants in the limestone mountains of Hungary they are violet-colored. It would seem from all observations that a number of factors are at work in producing colors in plants and that they are dependent upon conditions upon which we know very little.

6. The presence of hairs upon stigma, anther cells, side and spurred petals have possibly some significance when taken in connection with the shape of style (whether straight or with a knee-like bend) and length of spur of anther in assisting us to ascertain certain facts in the developmental history of this genus. Kerner considers that a style that is bent or deflexed is a device for impeding the progress of the insect into the flower so that all of the stamens are moved by the insect touching the 2-spurred ones and that the proboscis of the insect is thus covered with pollen. We would, therefore, conclude that in flowers with a straight style we have plants that are less differentiated and not so old in point of development. In this connection it is necessary, however, to consider also the development of hairs upon petals, stamens and stigma. Were these developed to impede, likewise, the progress

of beneficial insects or were they developed in the first place to keep out rain or injurious insects? The position of the flower (more or less resupinate) would indicate that the former is accomplished by this means alone. As to whether the plant first perfected all its parts for inducing cross fertilization and then produced other developments for protection from injurious influences, etc., are questions upon which a further morphological study of the genus will undoubtedly throw some light.

CLASSIFICATION OF THE GENUS.

I. From the observations made by the author up to the present time it would appear that one group is distinguished from all others by possessing a nearly globular stigma with a more or less lip-like appendage; a style with a knee-like bend in the lower portion; long hairs on the stamens and corkscrew-shaped hairs upon the spurred petal; the spur of the stamen is 2.0–2.8 mm. in length. This group comprises *V. heterophylla* (Fig. 4), *V. lutea* (Fig. 3), *V. tricolor vulgaris* (Fig. 1), *V. tricolor arvensis* (Fig. 2).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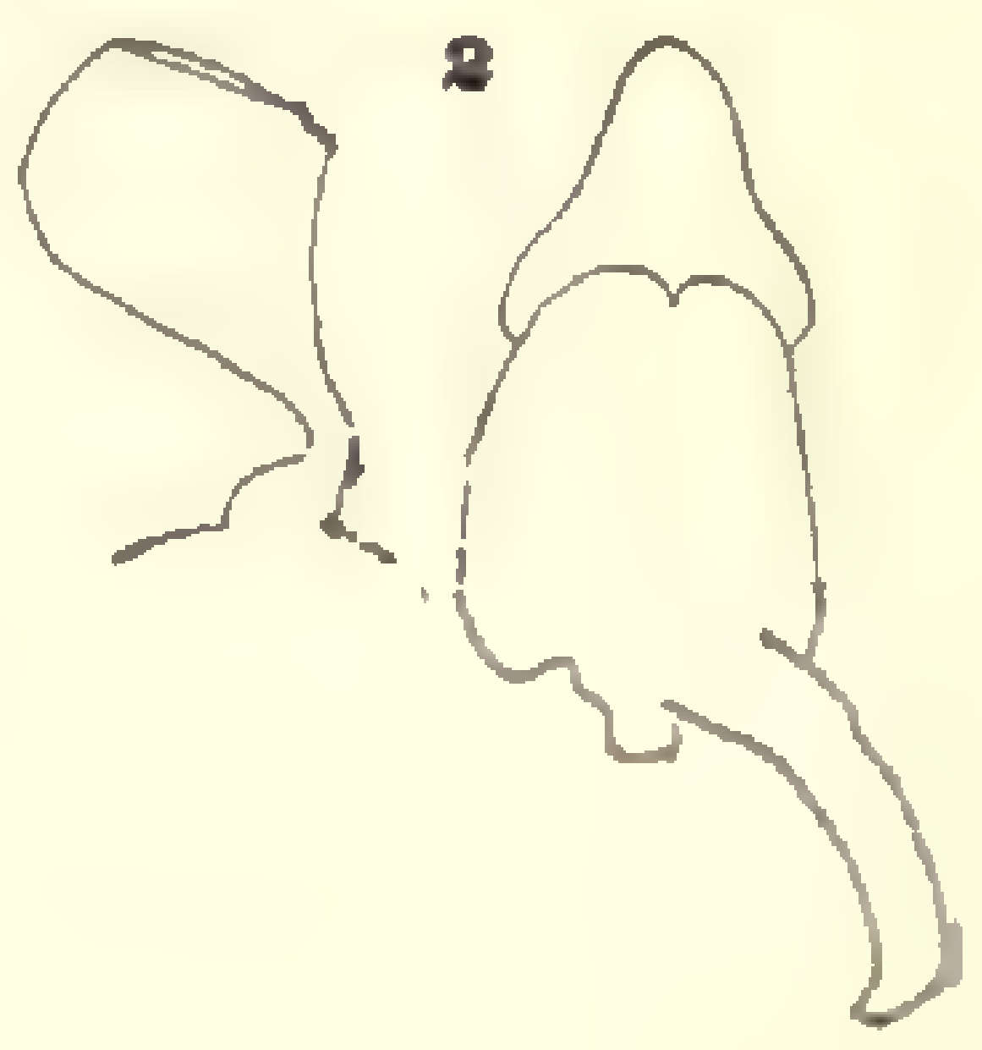
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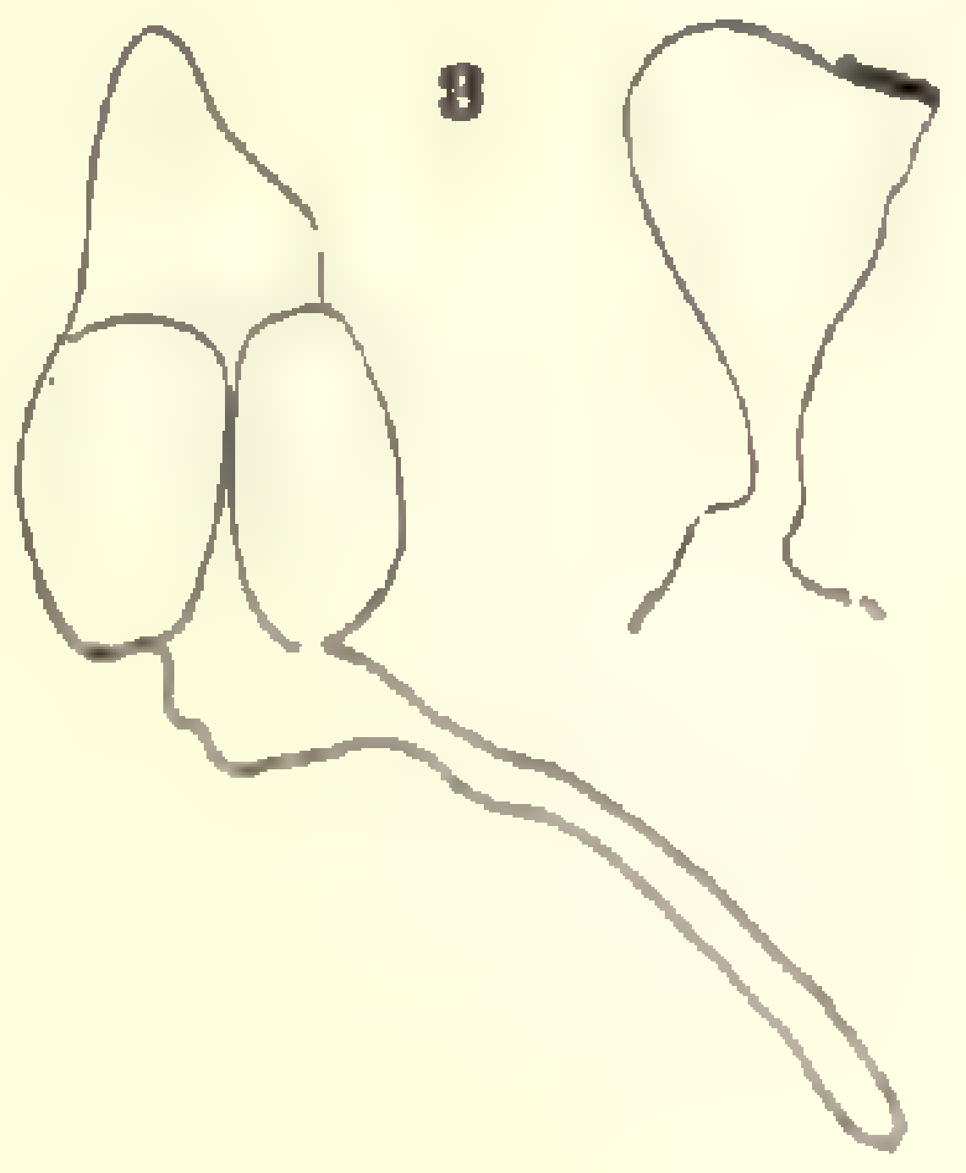
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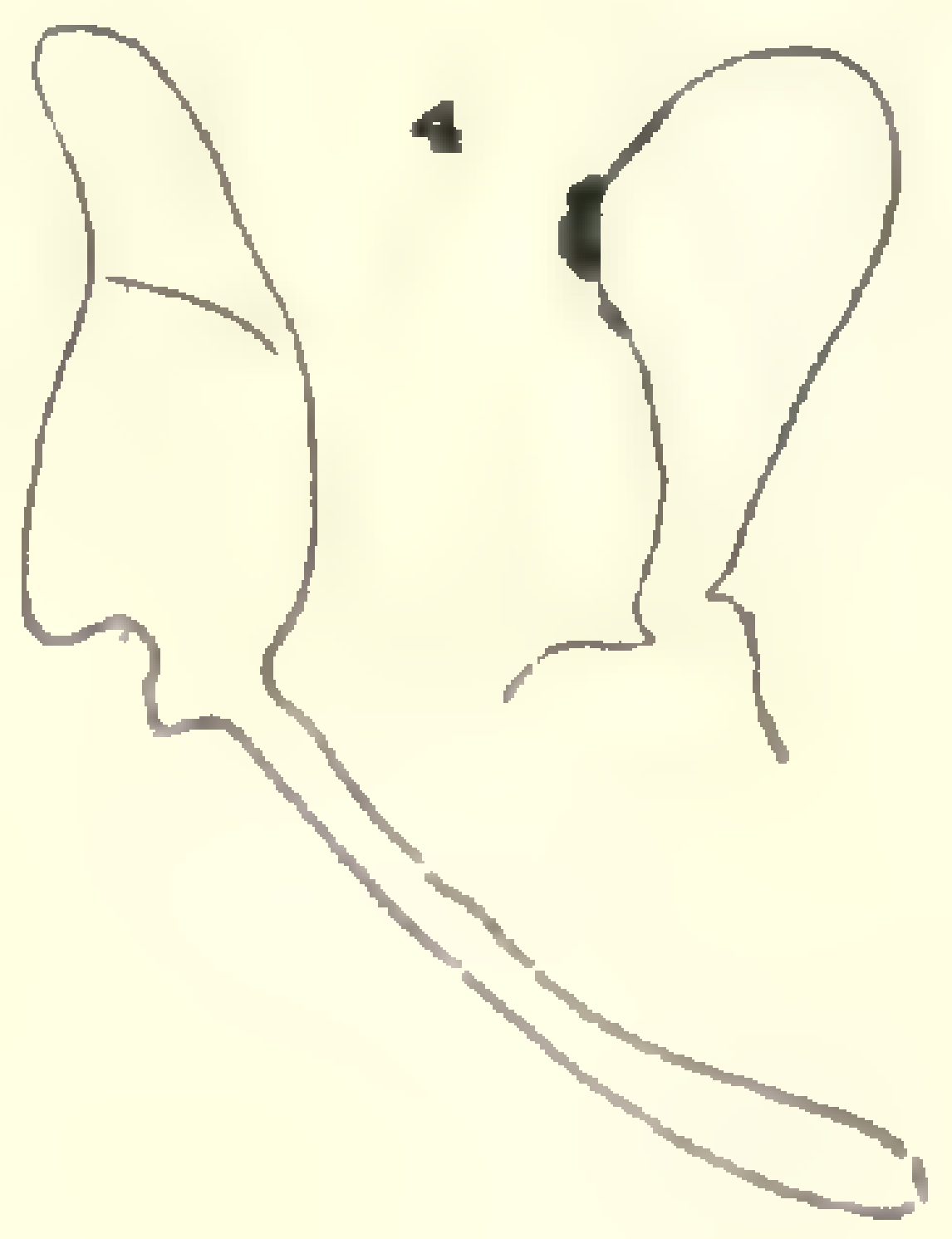
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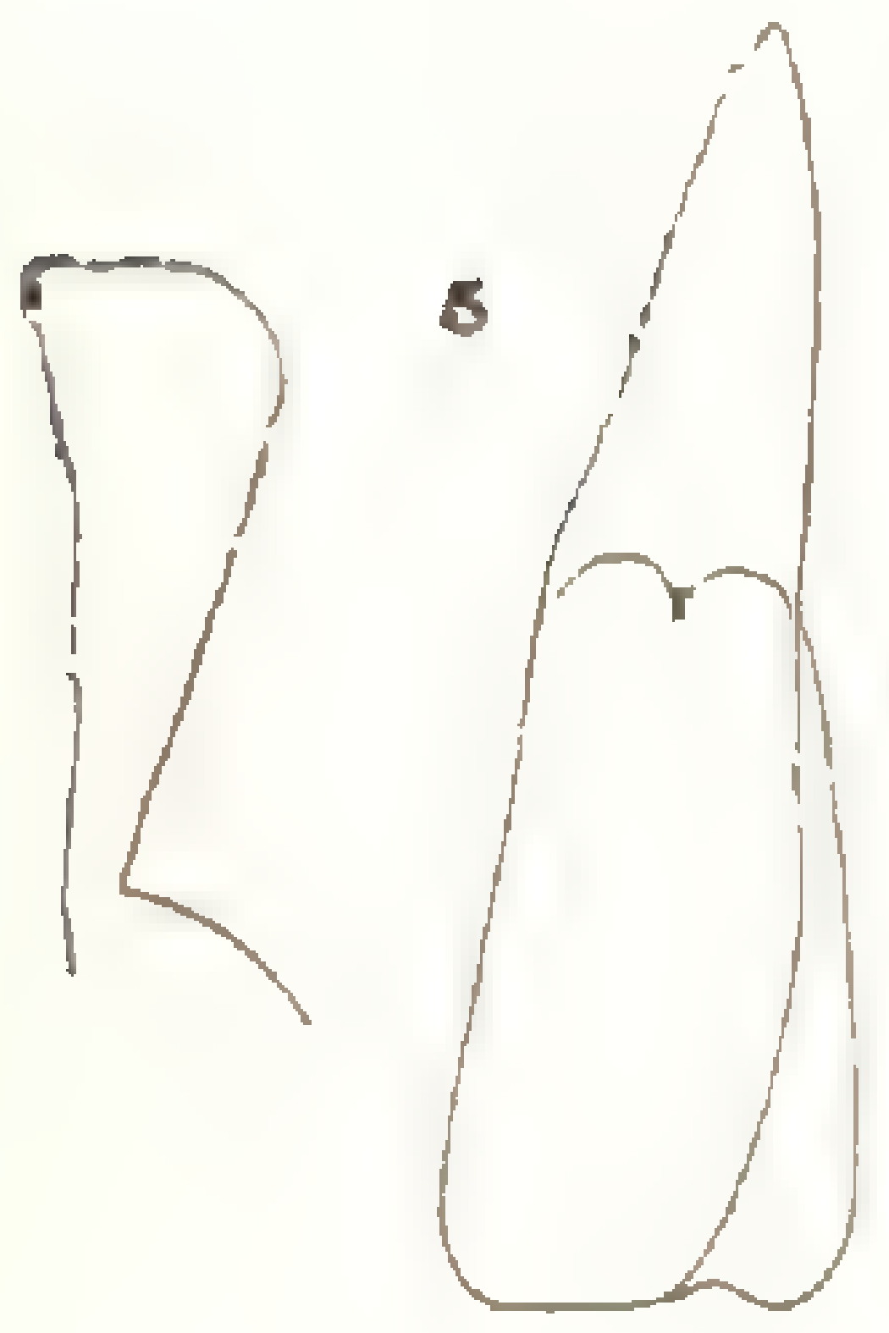
II. The remaining species are characterized by a stigma that is slightly greater in diameter than the style or is somewhat globular with a beak-like projection at the apex of which the opening for the entrance of the pollen grains is located or there may be also a posterior but closed projection; the style is either bent or straight, the stamens are free from long hairs, the length of spur of stamen varies in different species, and the hairs if present on the spurred petal are straight. This group comprises:

A. Spur of stamen is of the same length as anther cells: *V. ro-*

tundifolia (Fig. 5), *V. Canadensis* (Fig. 6), *V. Nuttallii* (Fig. 7), *V. hastata* (Fig. 8), *V. pubescens* (Fig. 9), *V. scabriuscula* (Fig. 10) and *V. tripartita* (Fig. 11 simple leaved plant; Fig. 12, plant from moist woods).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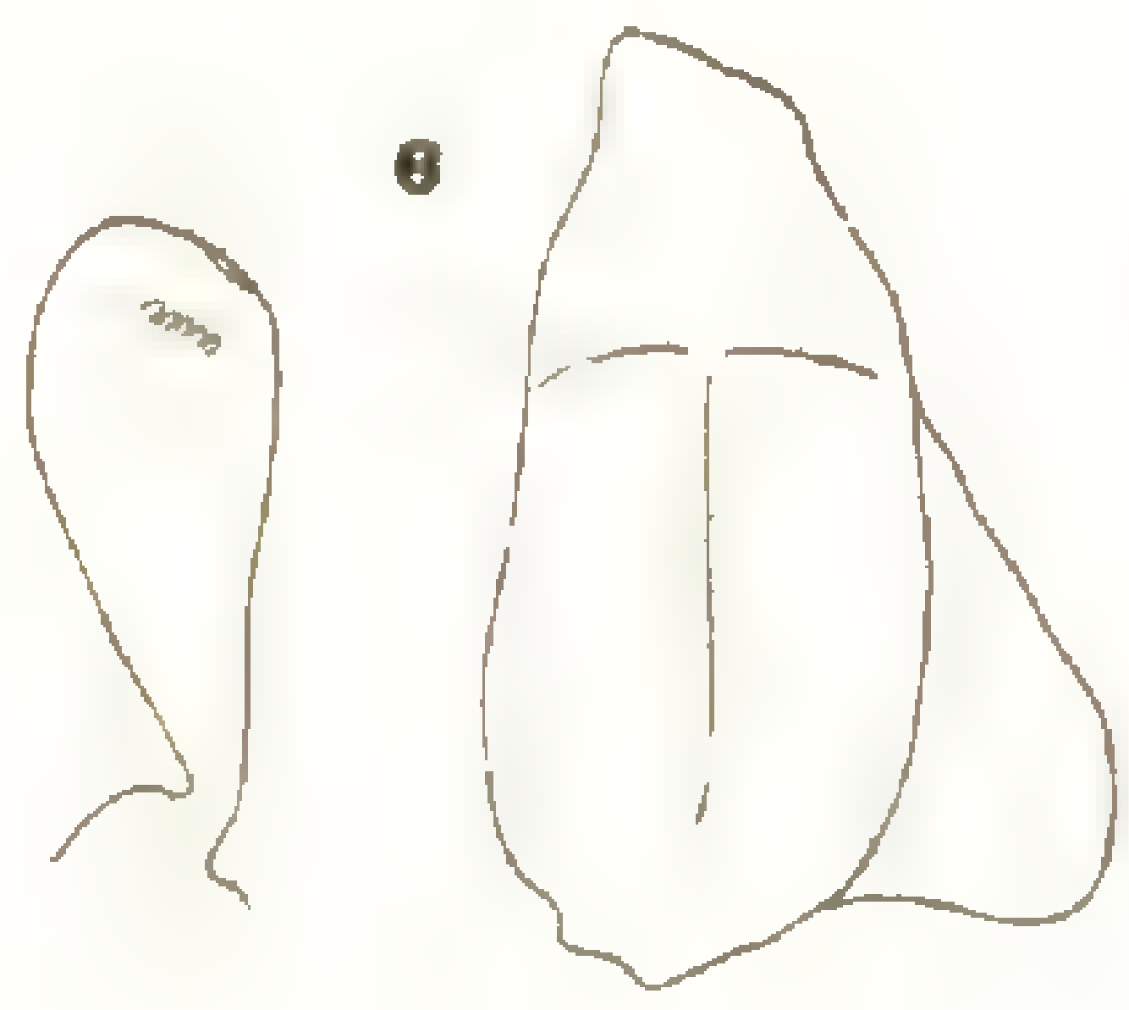
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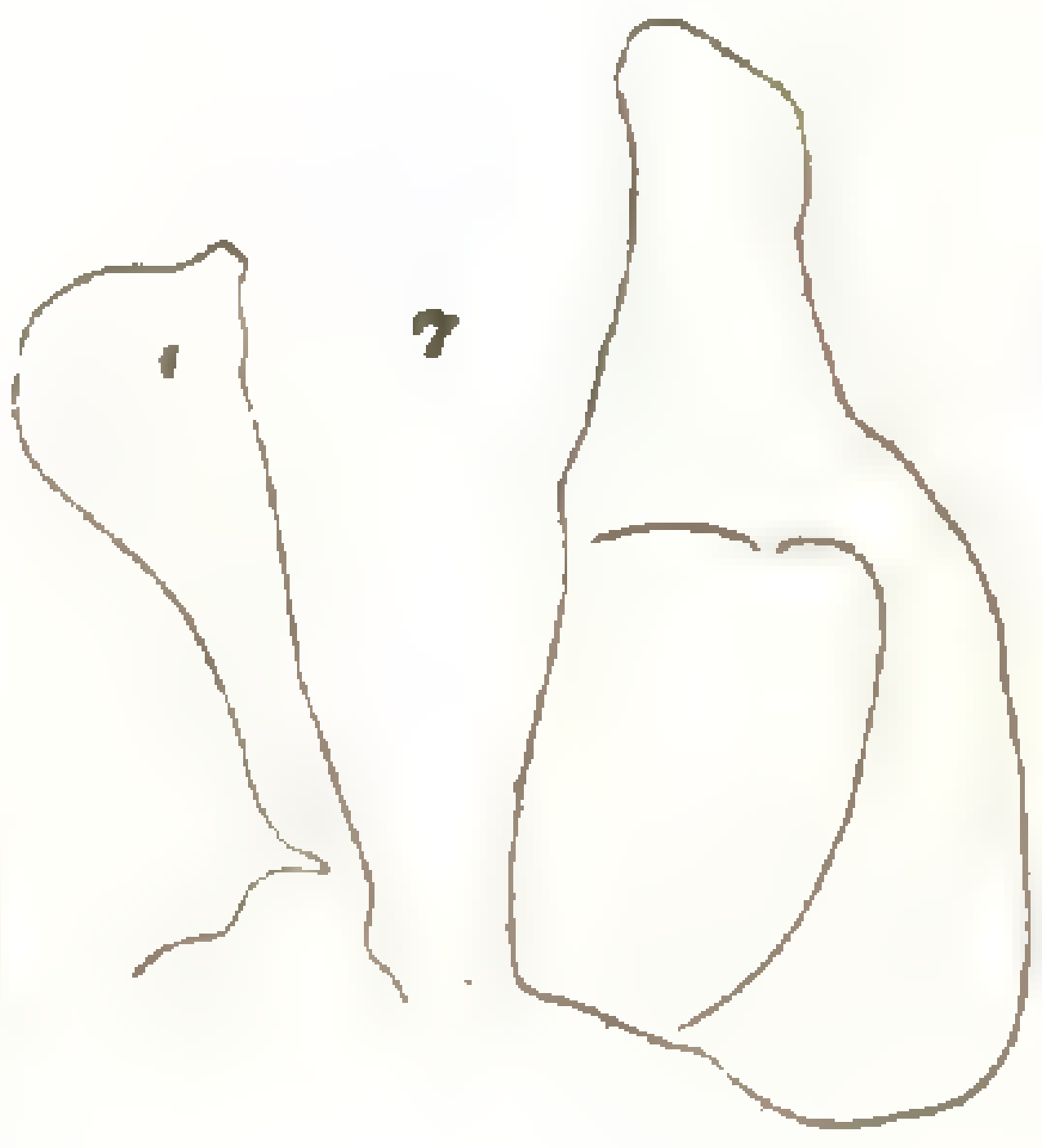
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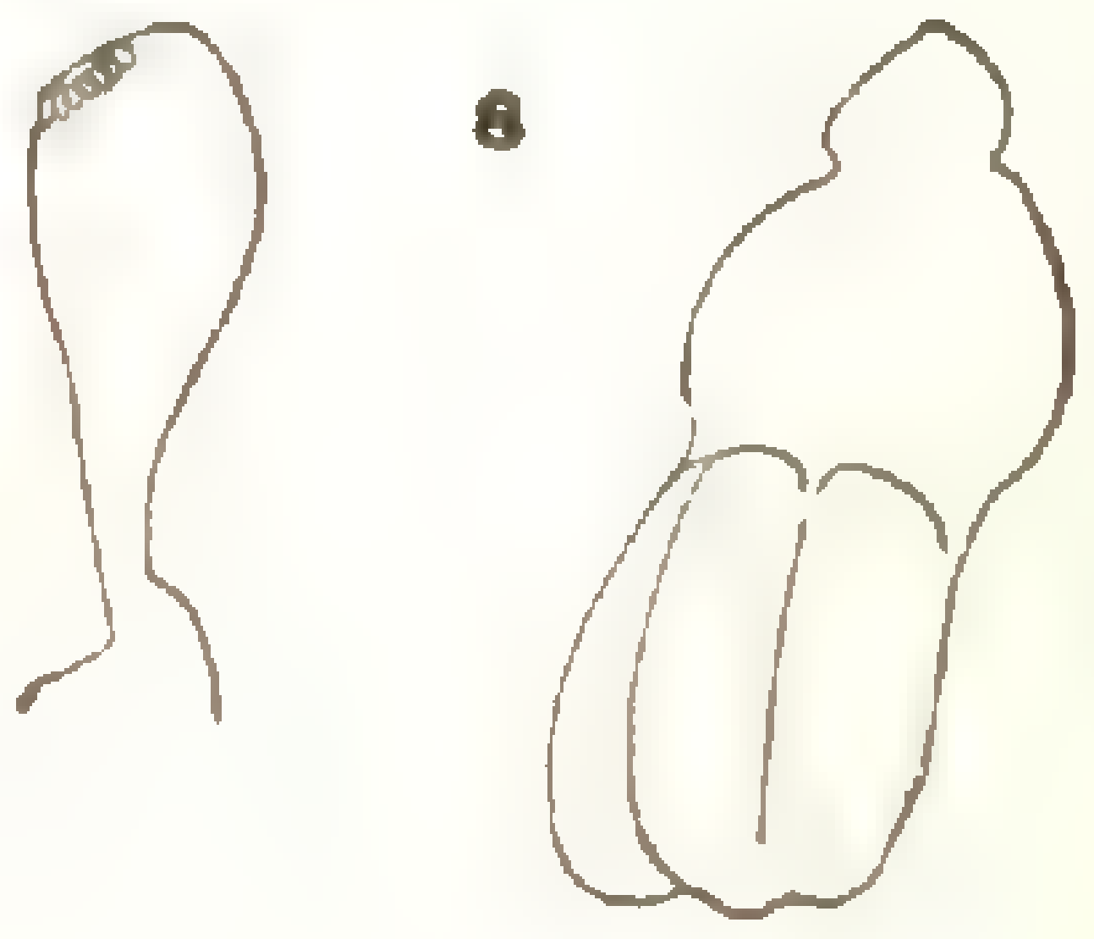
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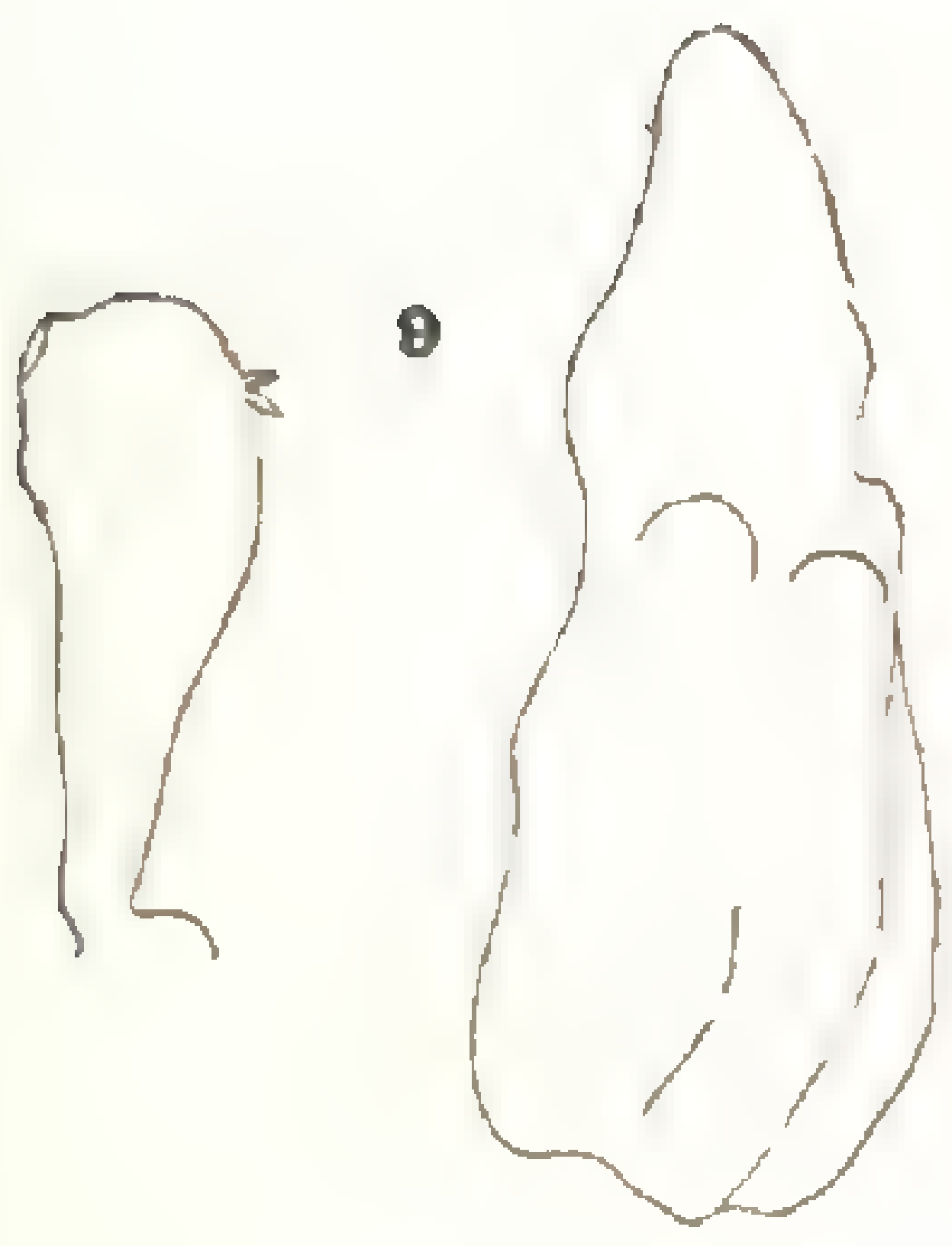
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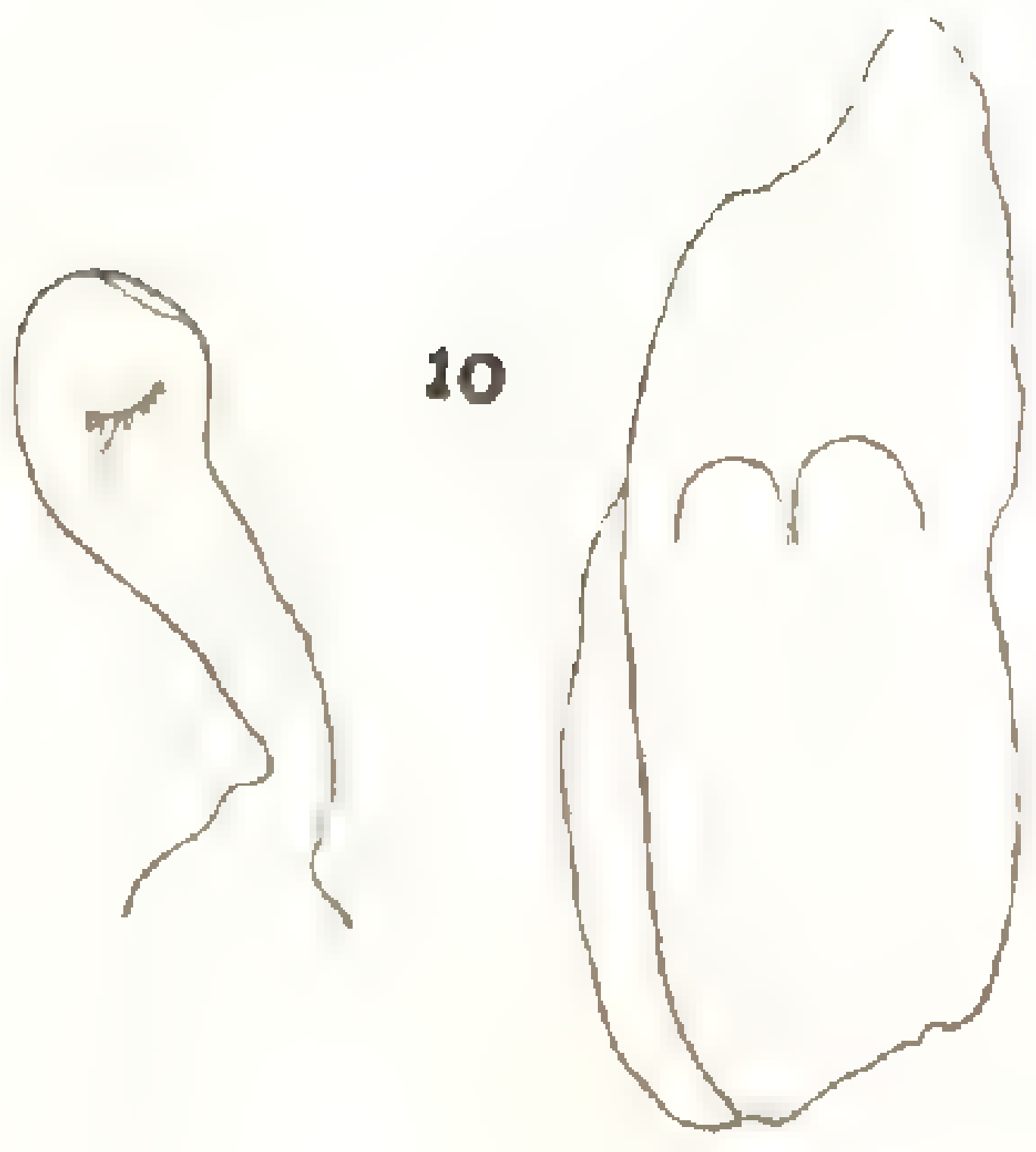
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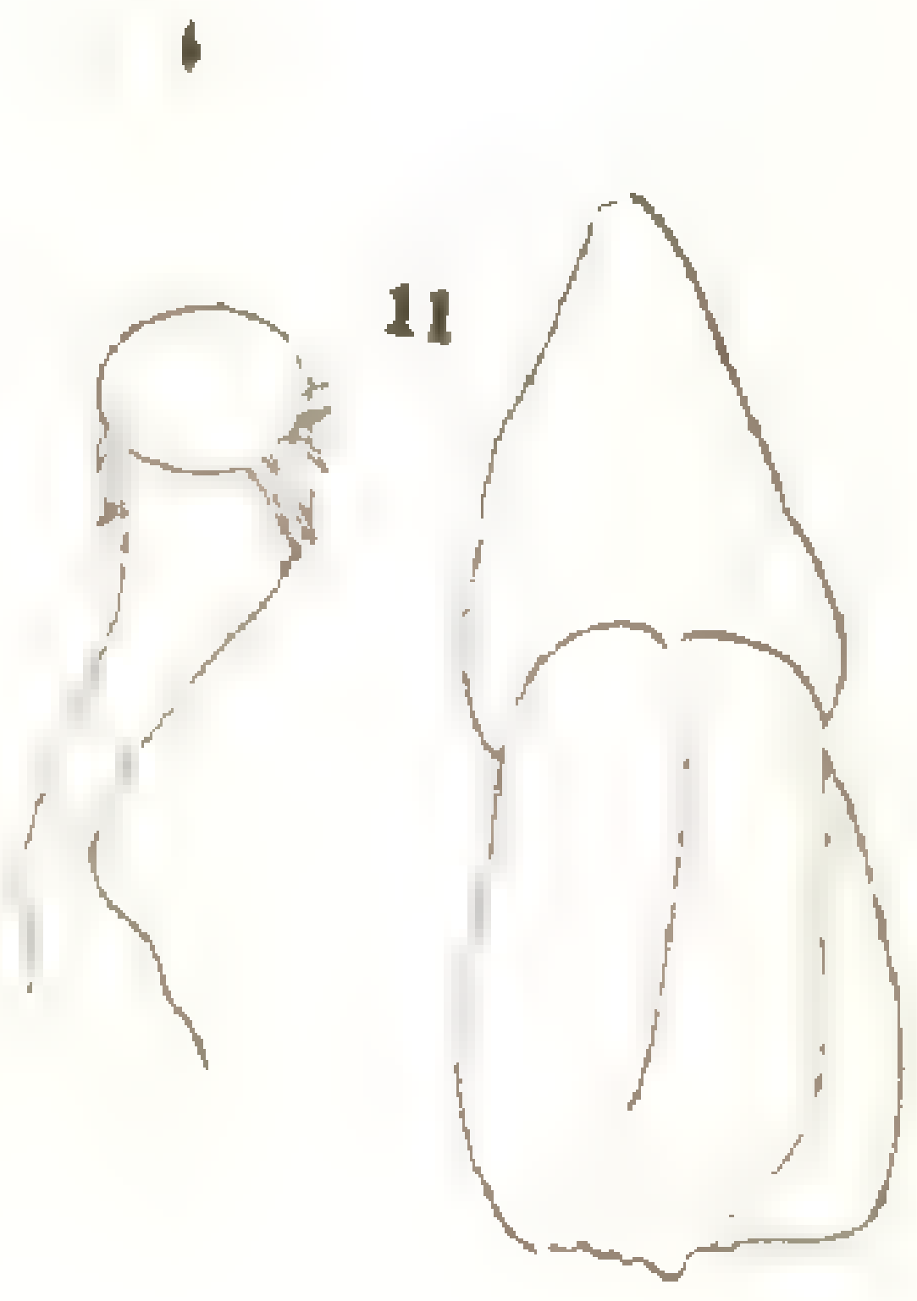
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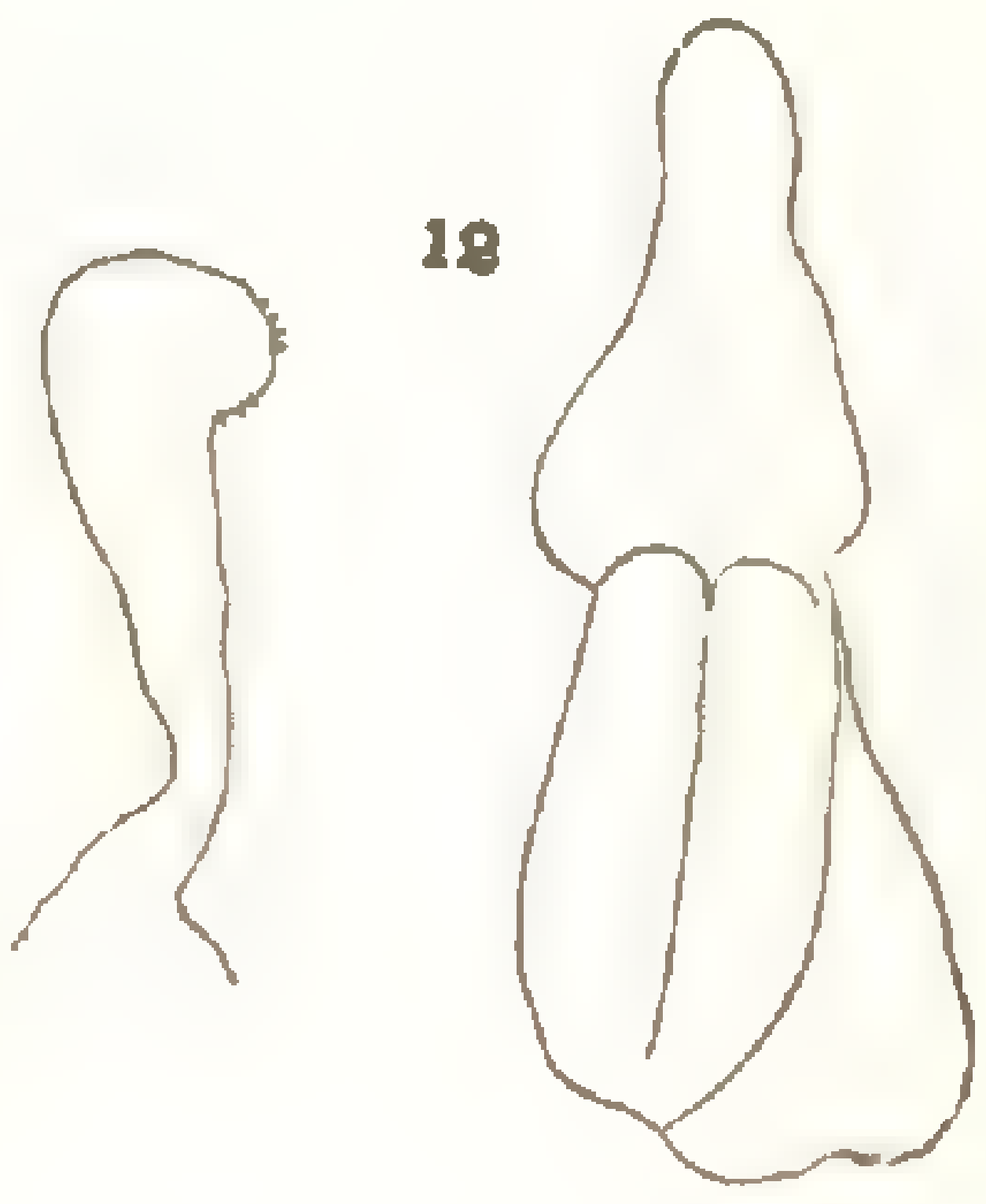
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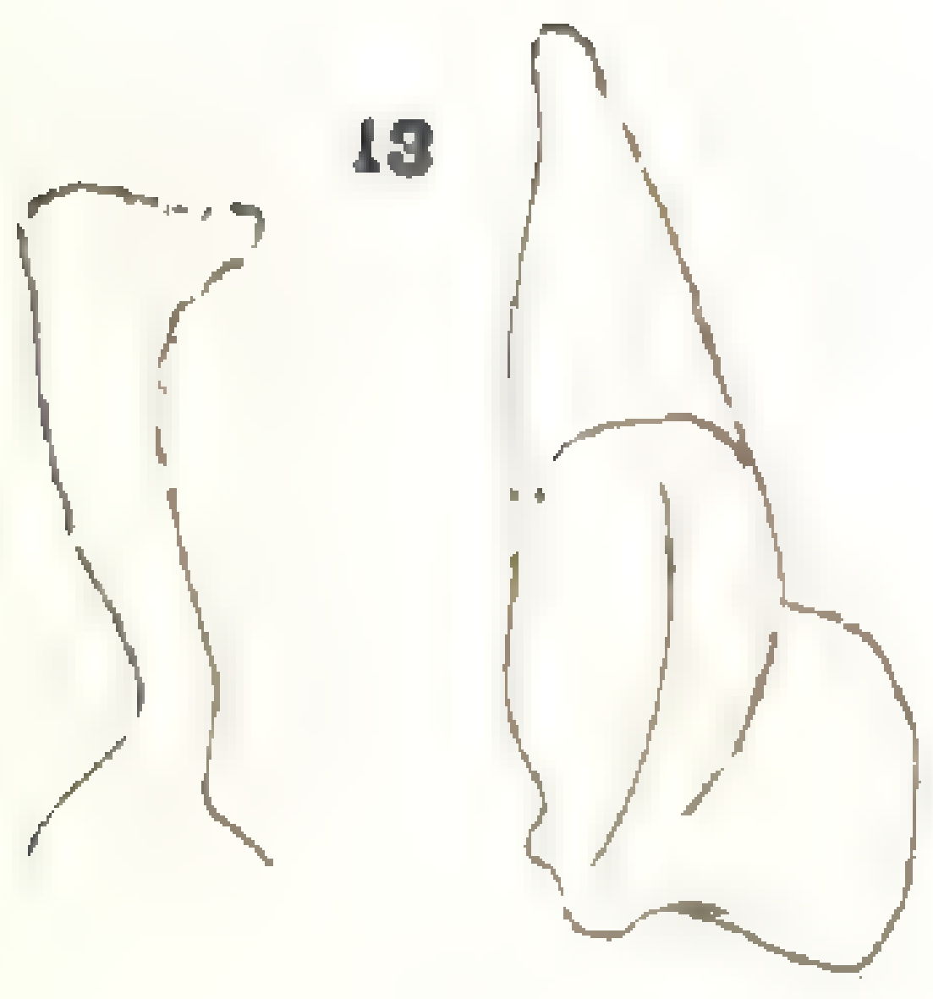
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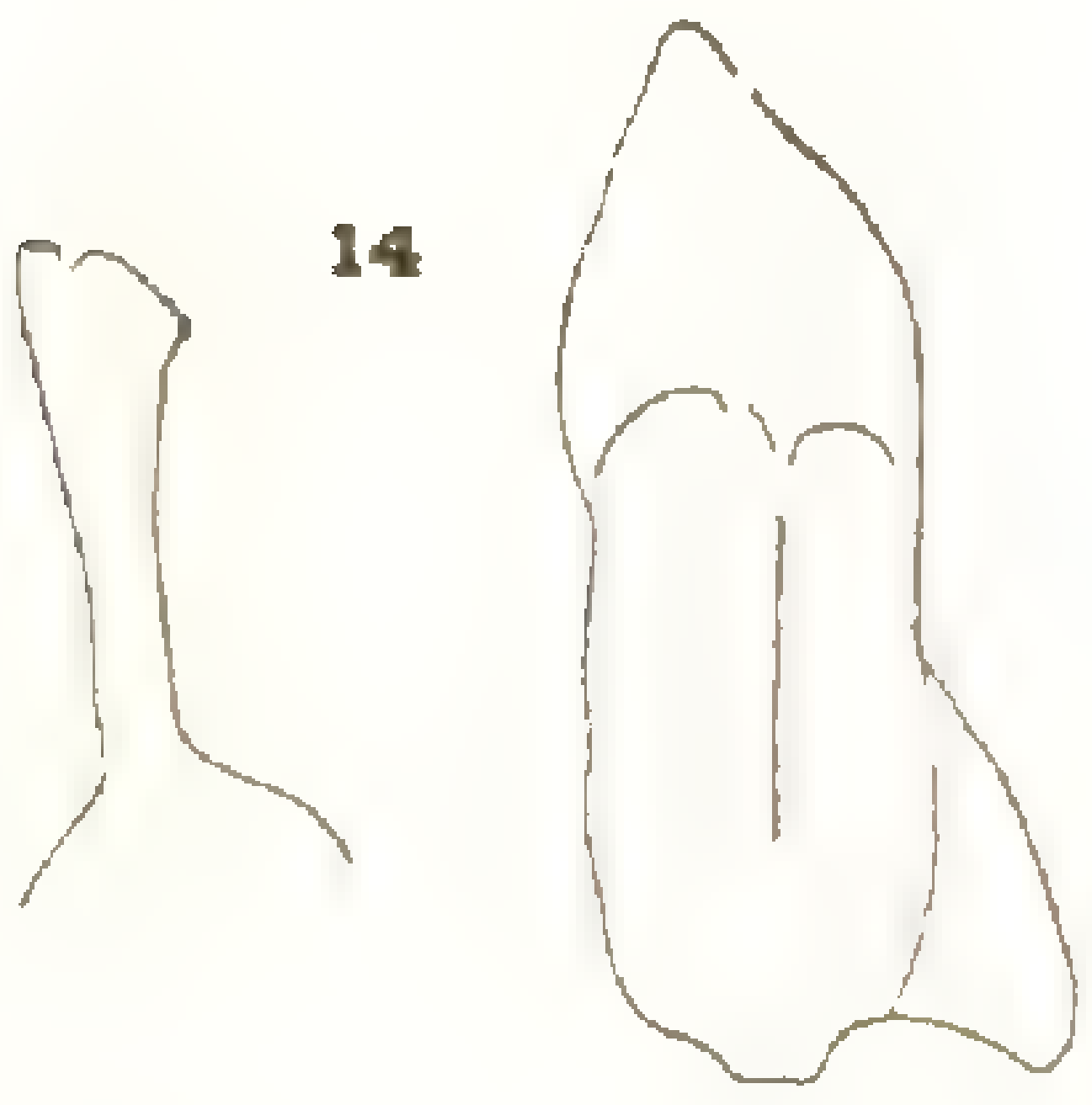
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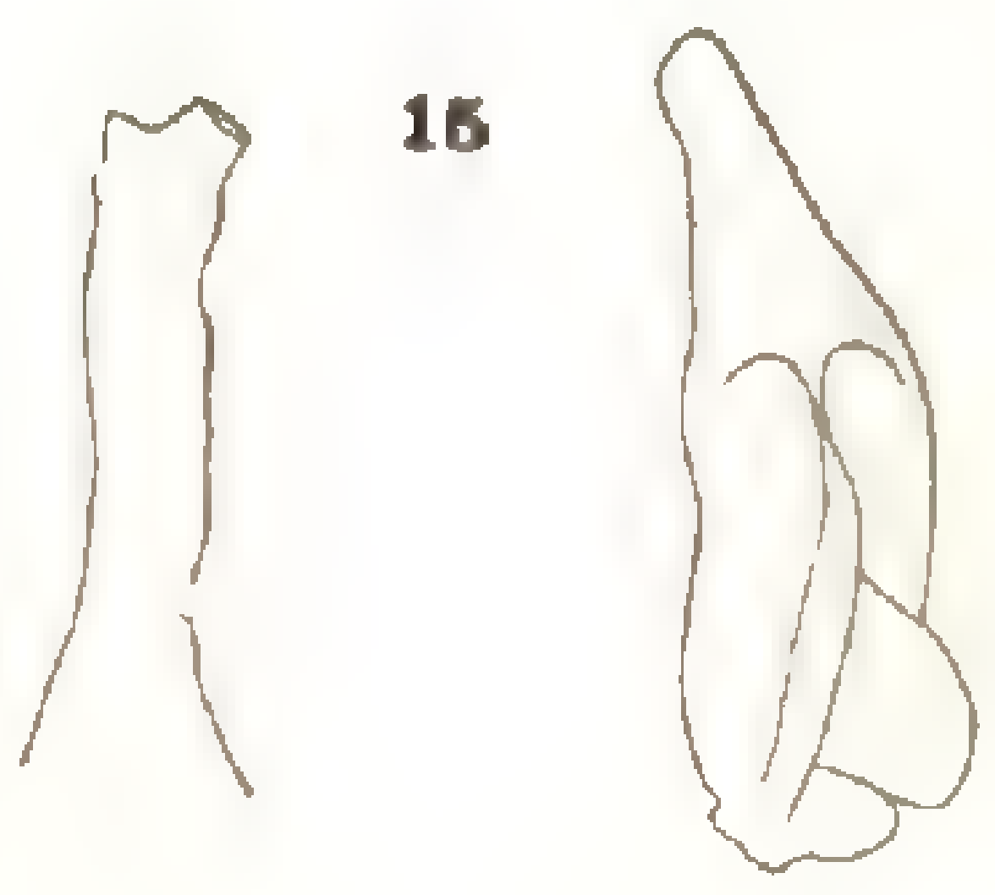
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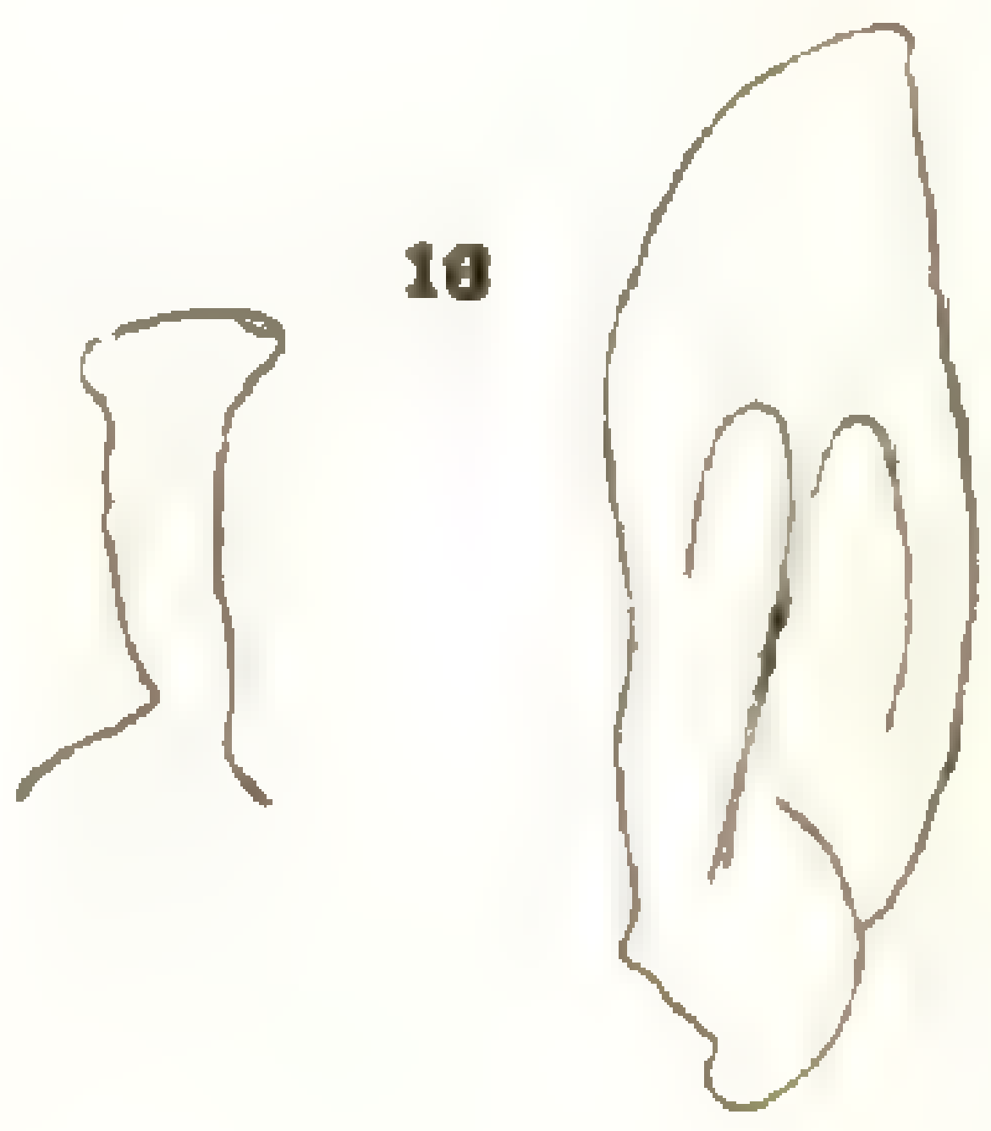
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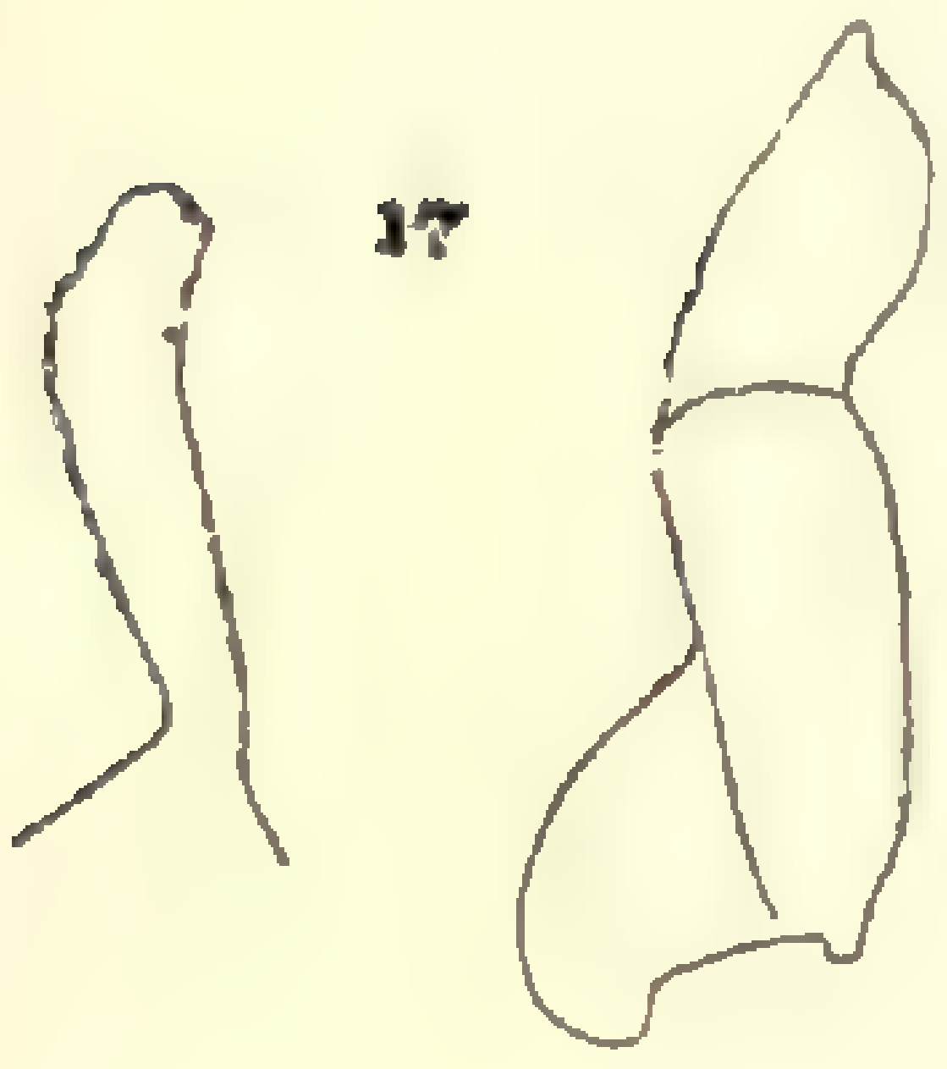
B. Spur of stamen is less than the anther cells in length; *V. blanda* (Fig. 13), *V. primulaefolia* (Fig. 14), *V. lanceolata* (Fig. 15), *V. palustris* (Fig. 16), and *V. renifolia* (Fig. 17).

C. Spur of stamen extends 1.5 to 1.8 mm. below anther cells: *V. pedata* (Fig. 18) and *V. ovata* (Fig. 19).

D. Spur of stamen extends 2.3 to 3.6 mm. below anther cells.



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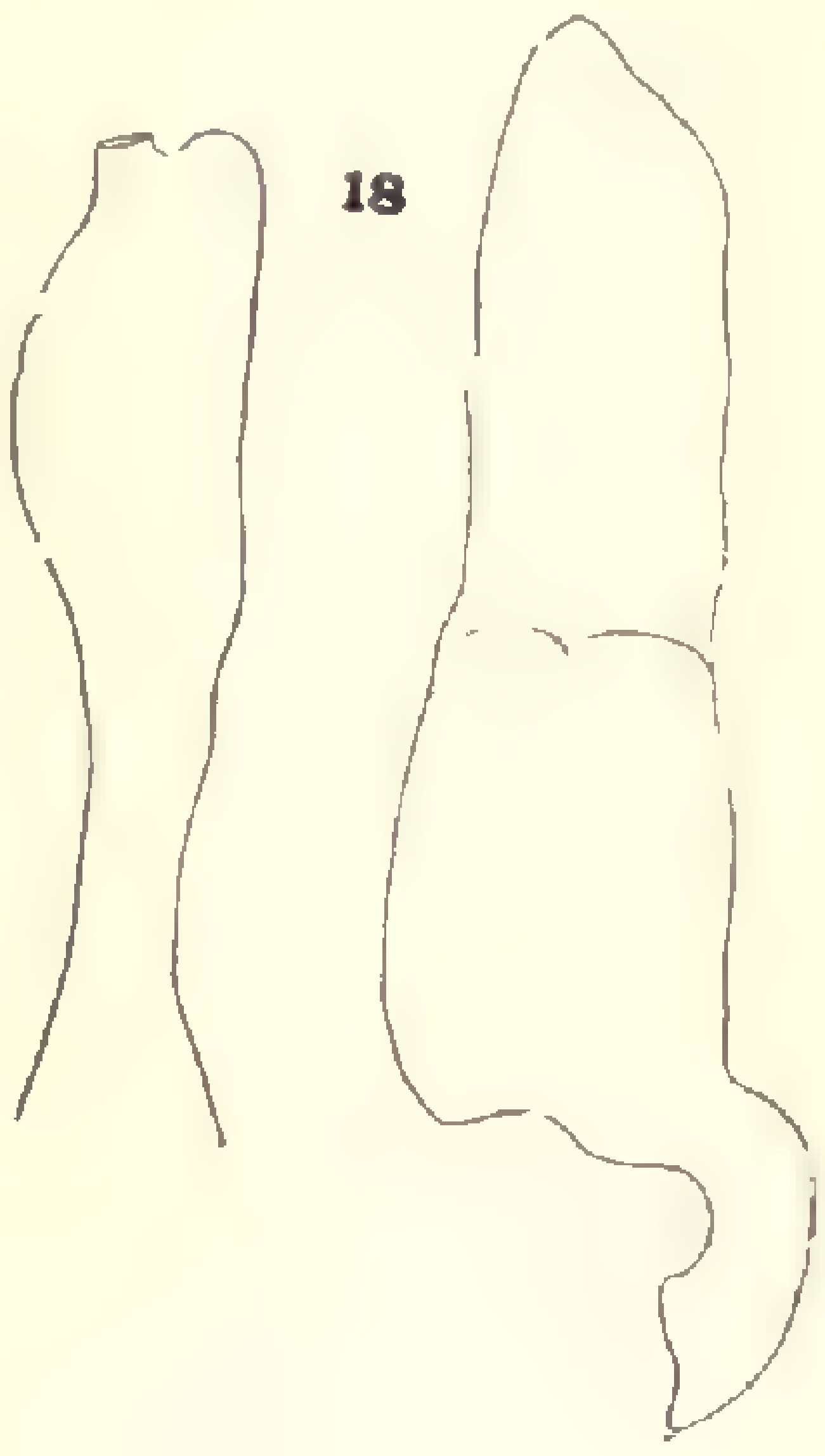

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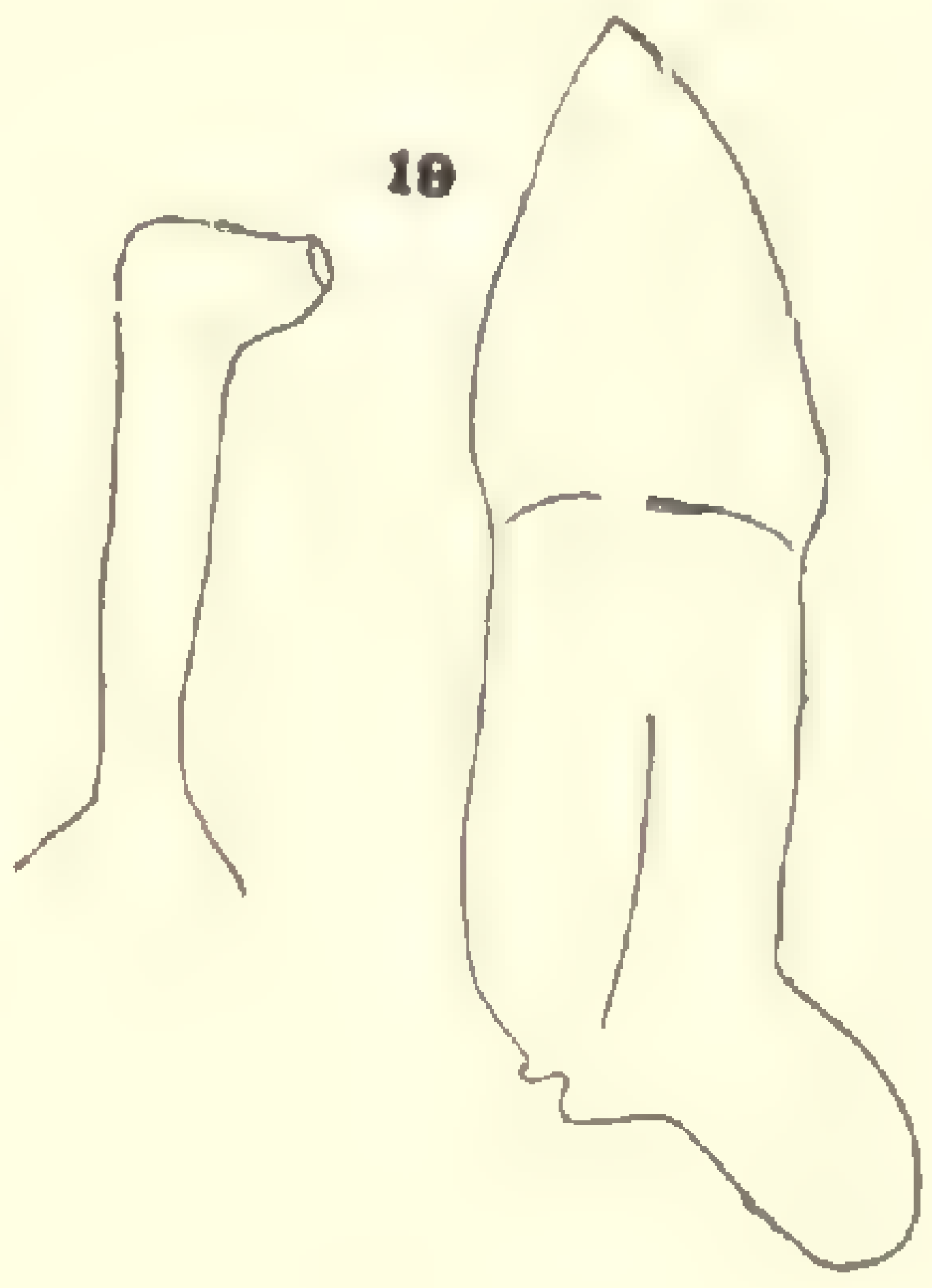

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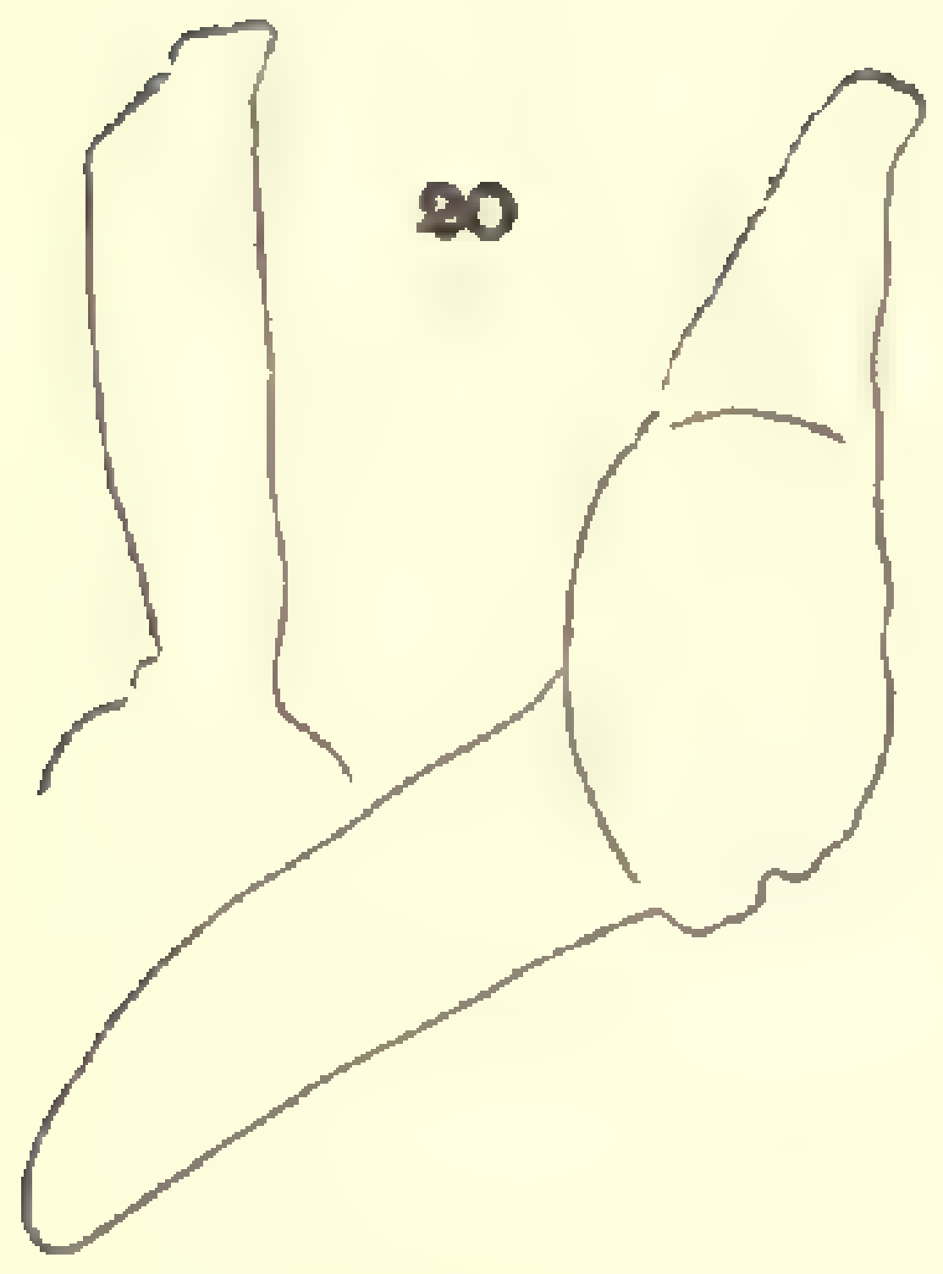

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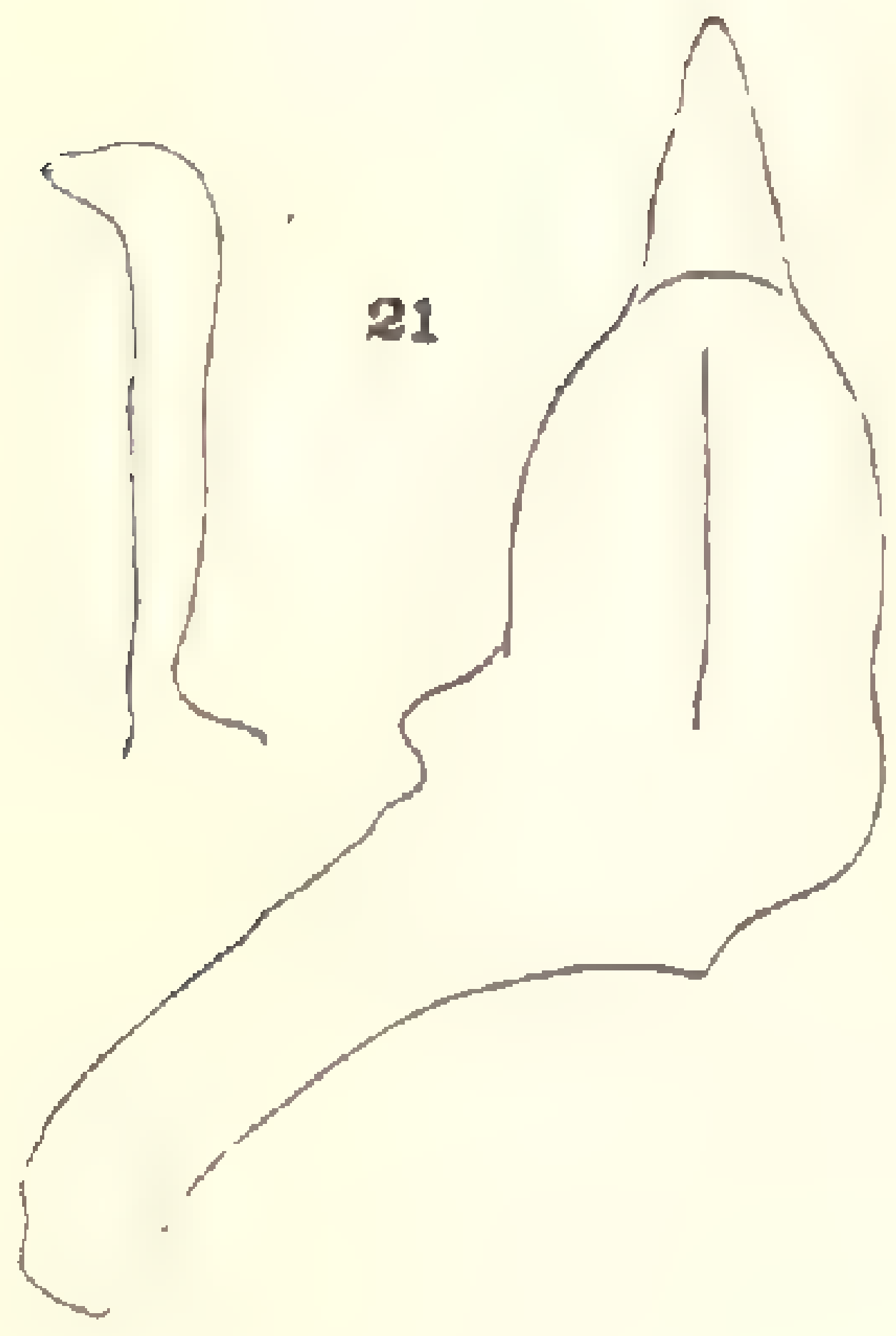

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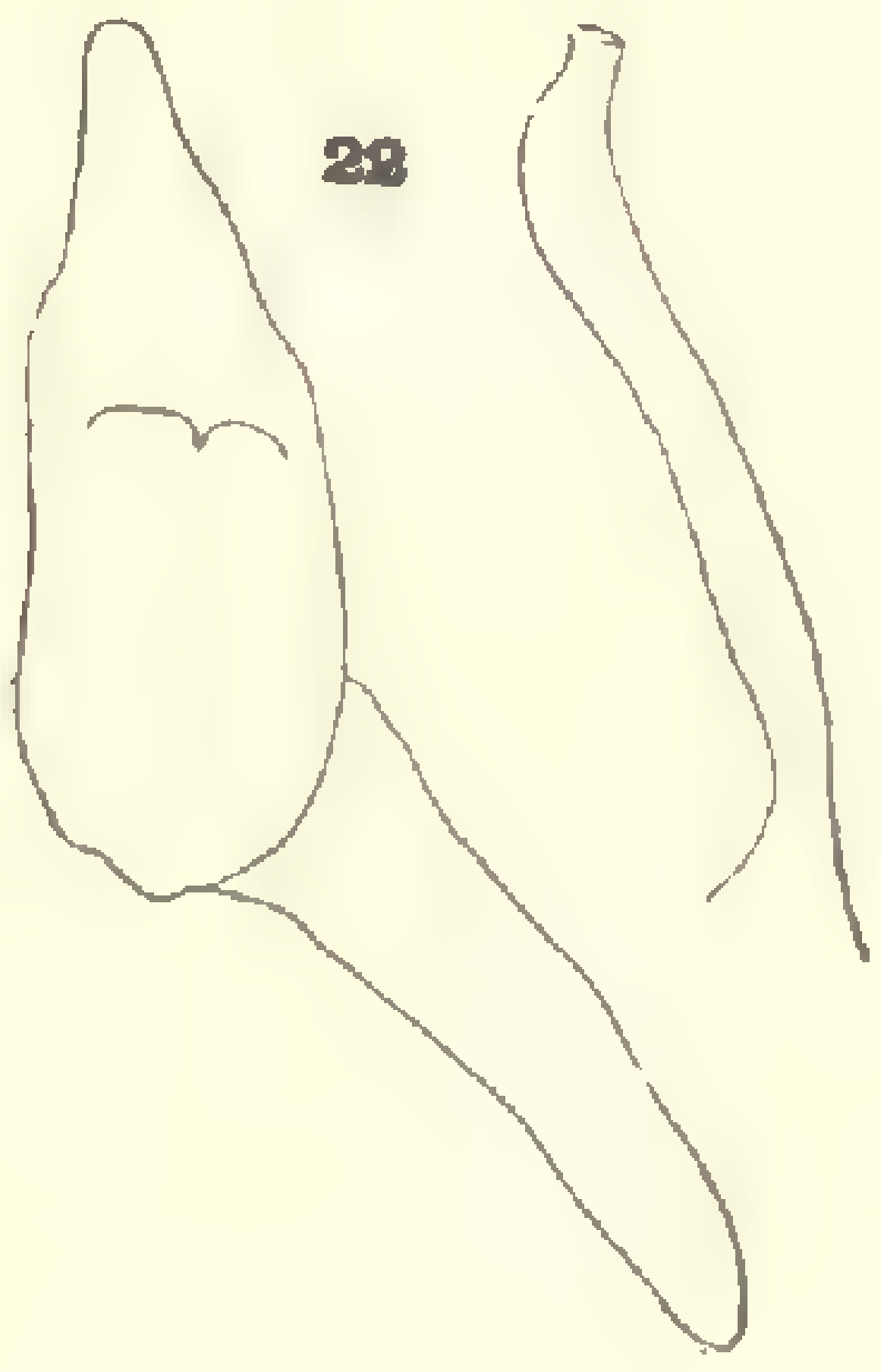

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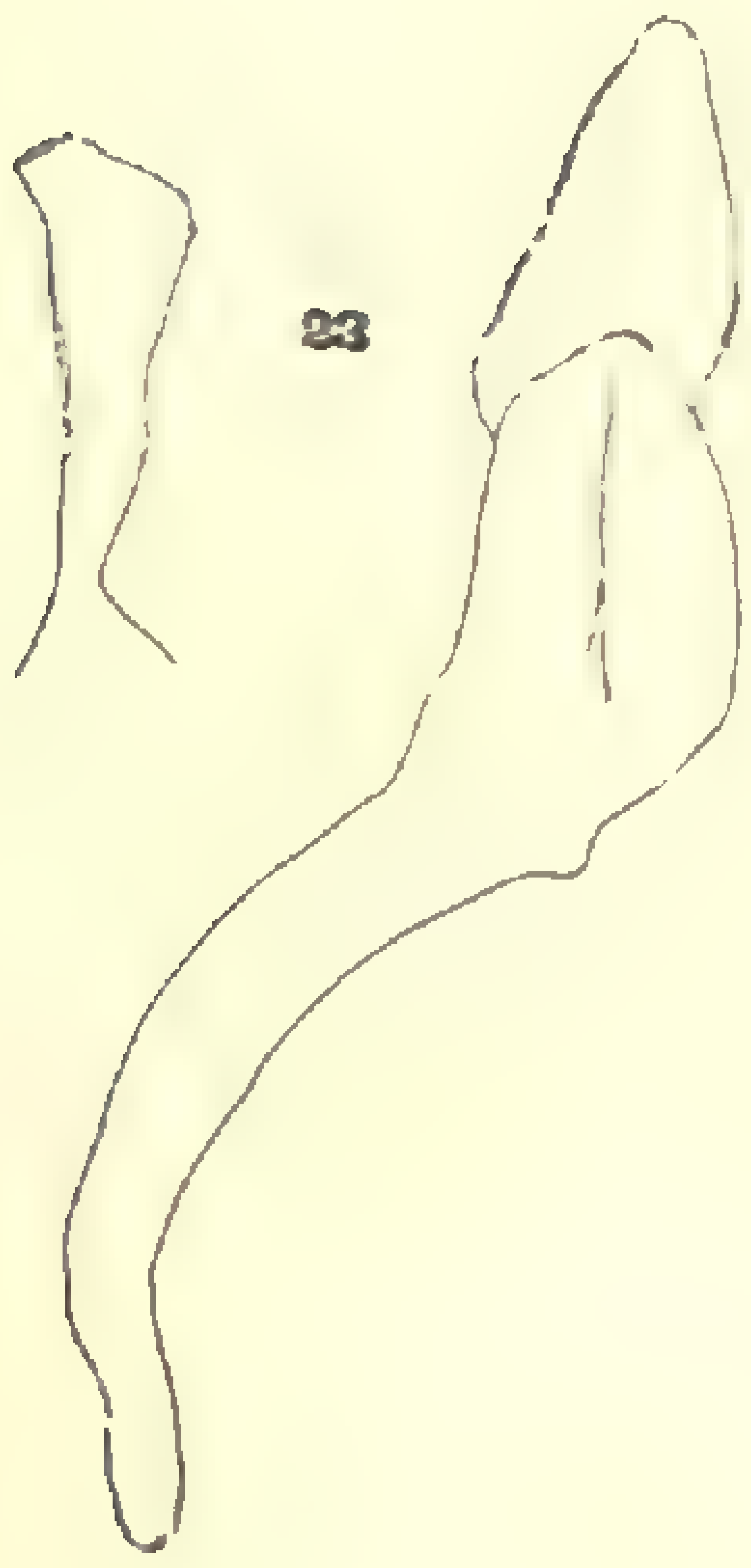

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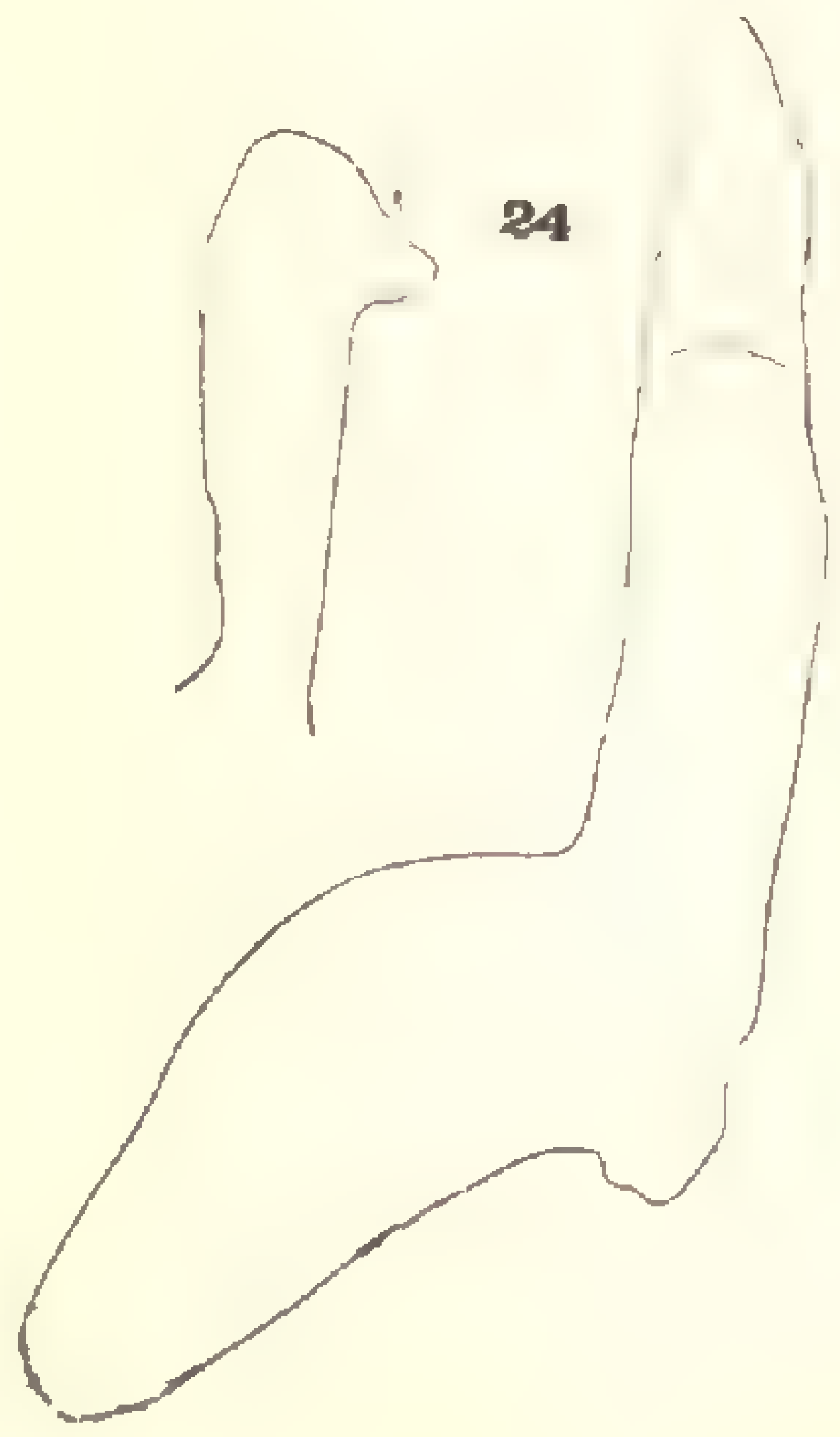

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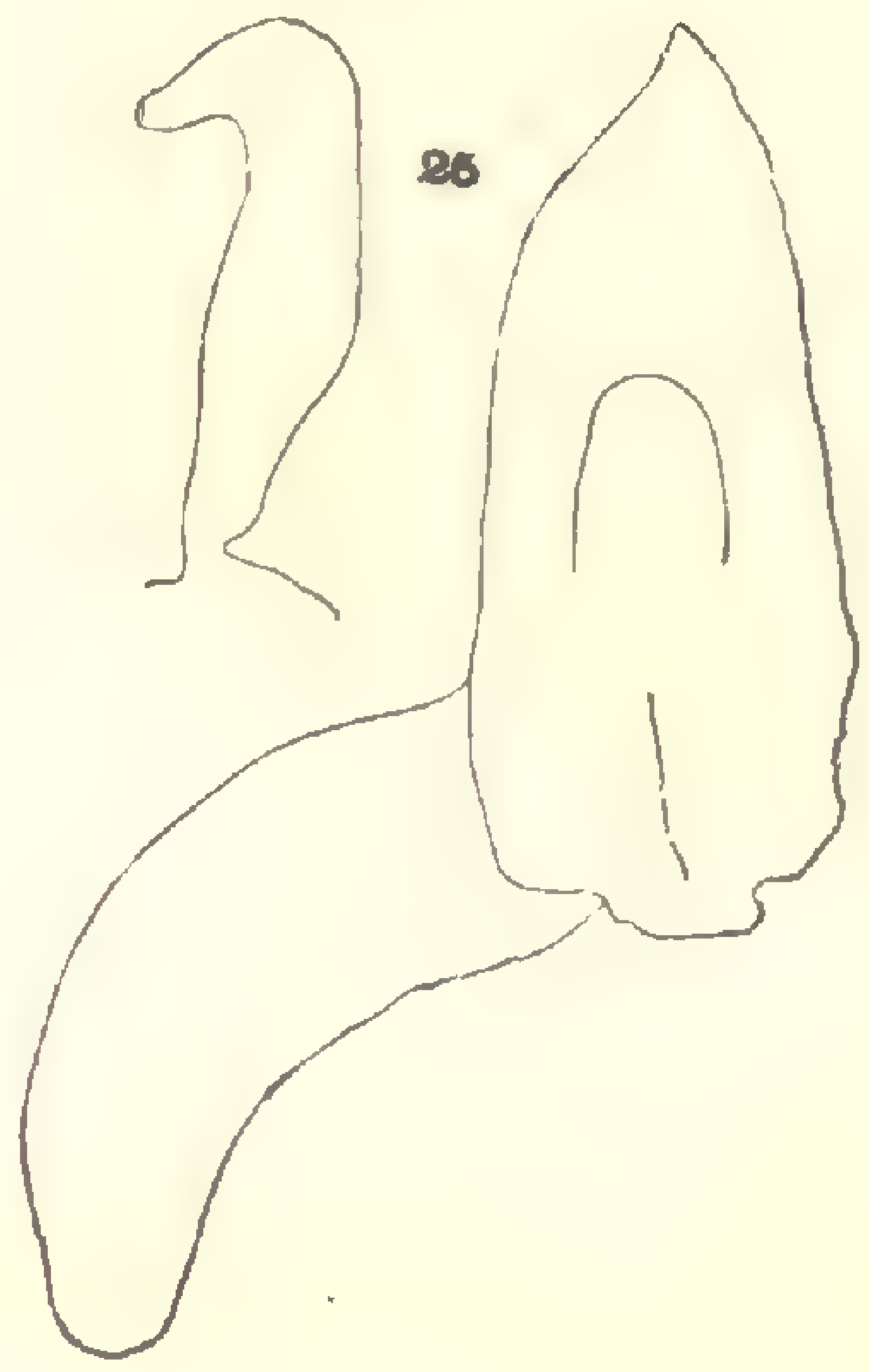

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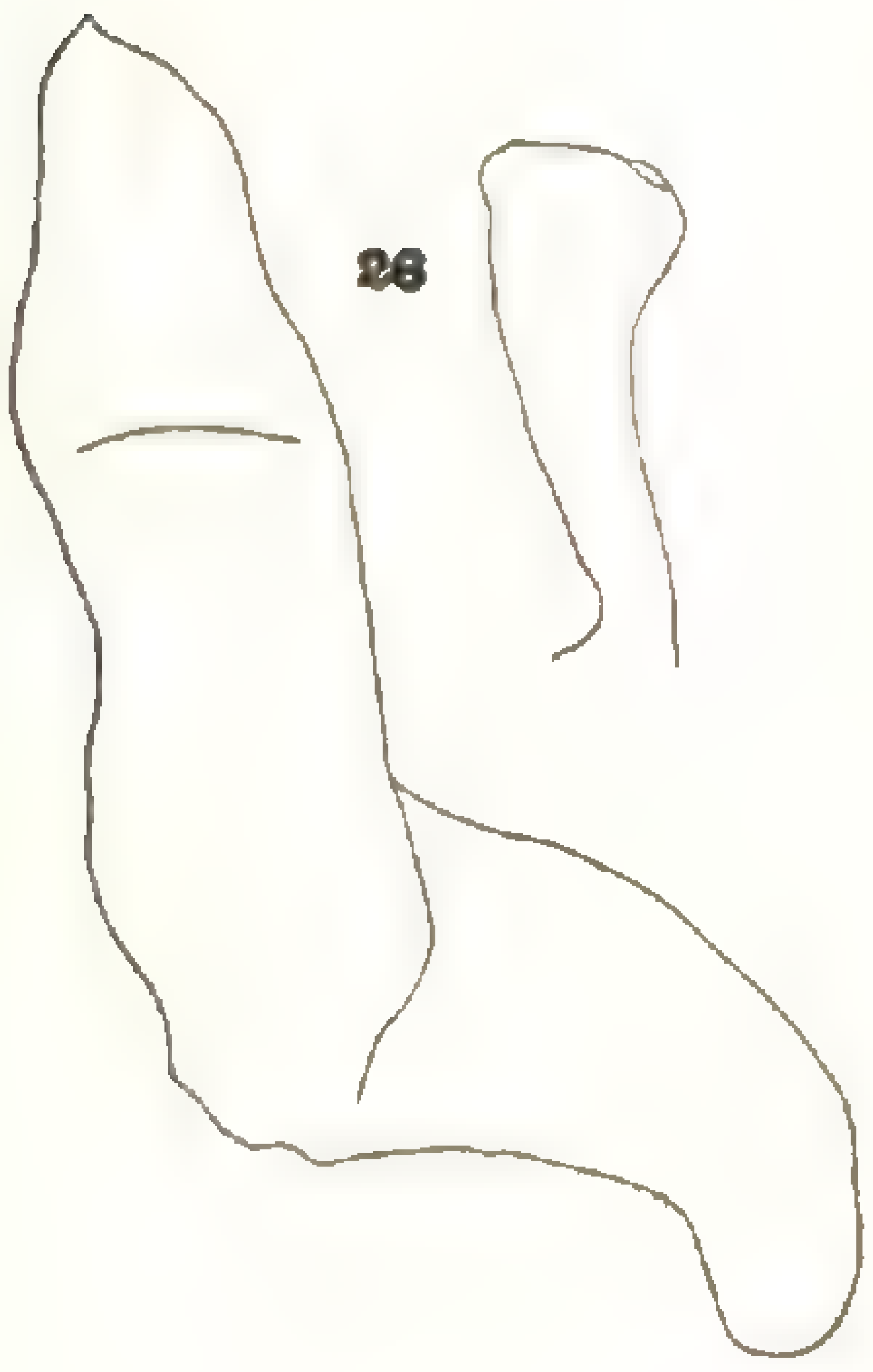
This group may be further subdivided according to the width of spur at its widest portion into:

(*a*) Spur .7 to .8 mm. wide at the widest portion: *V. arenaria* (Fig. 20), *V. Labradorica* (Fig. 21), *V. striata* (Fig. 22) and *V. Selkirkii* (Fig. 23).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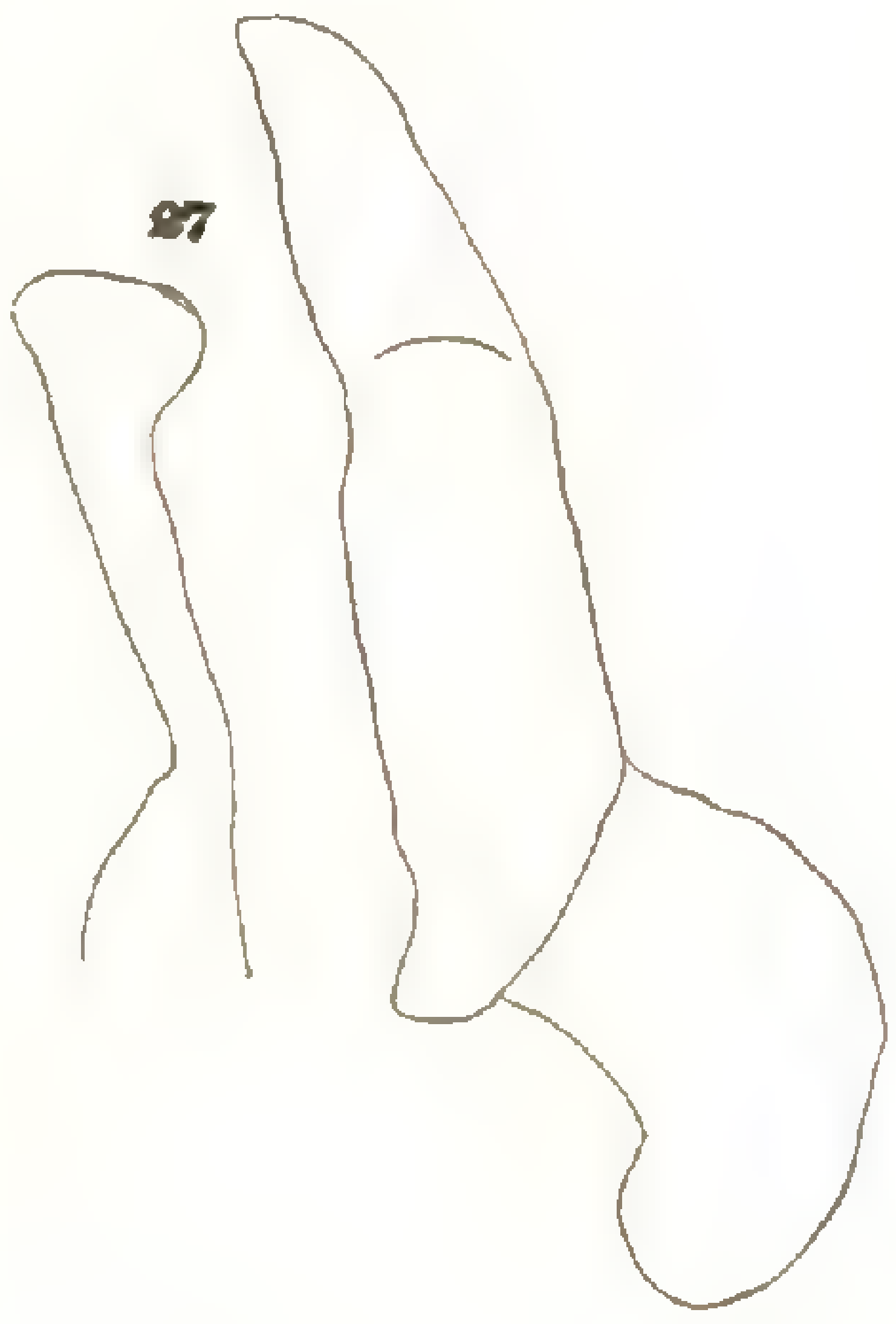
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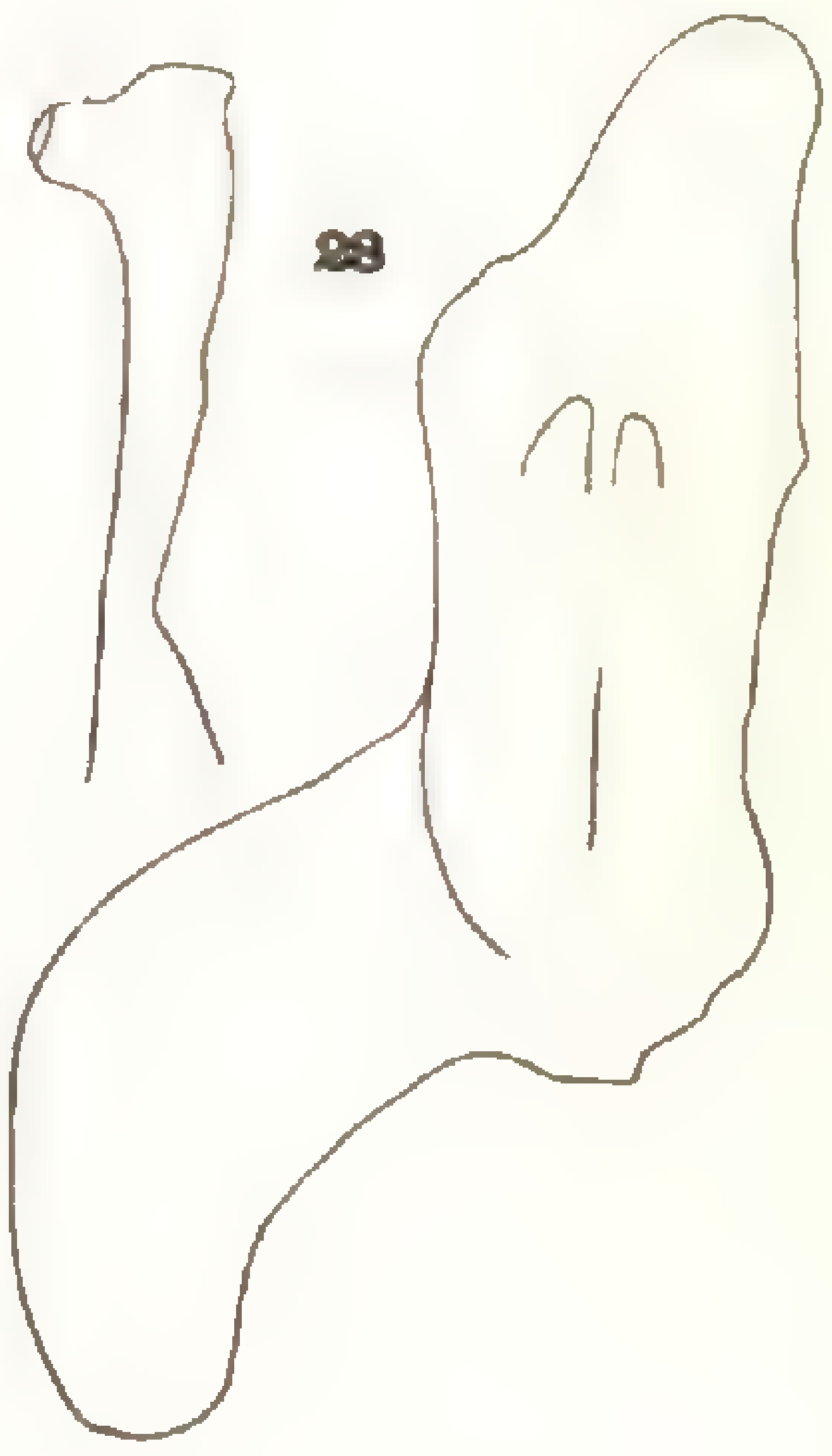
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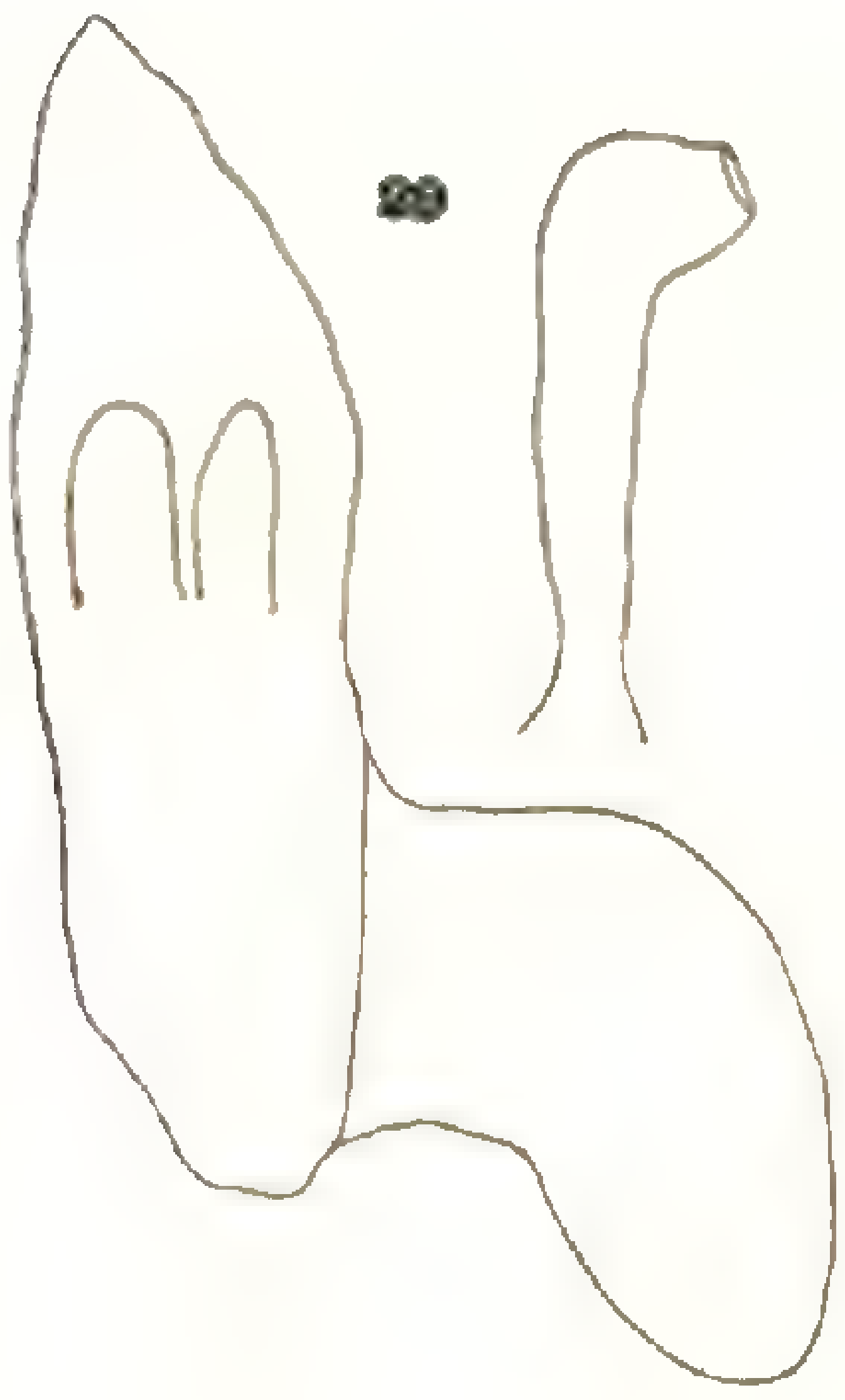
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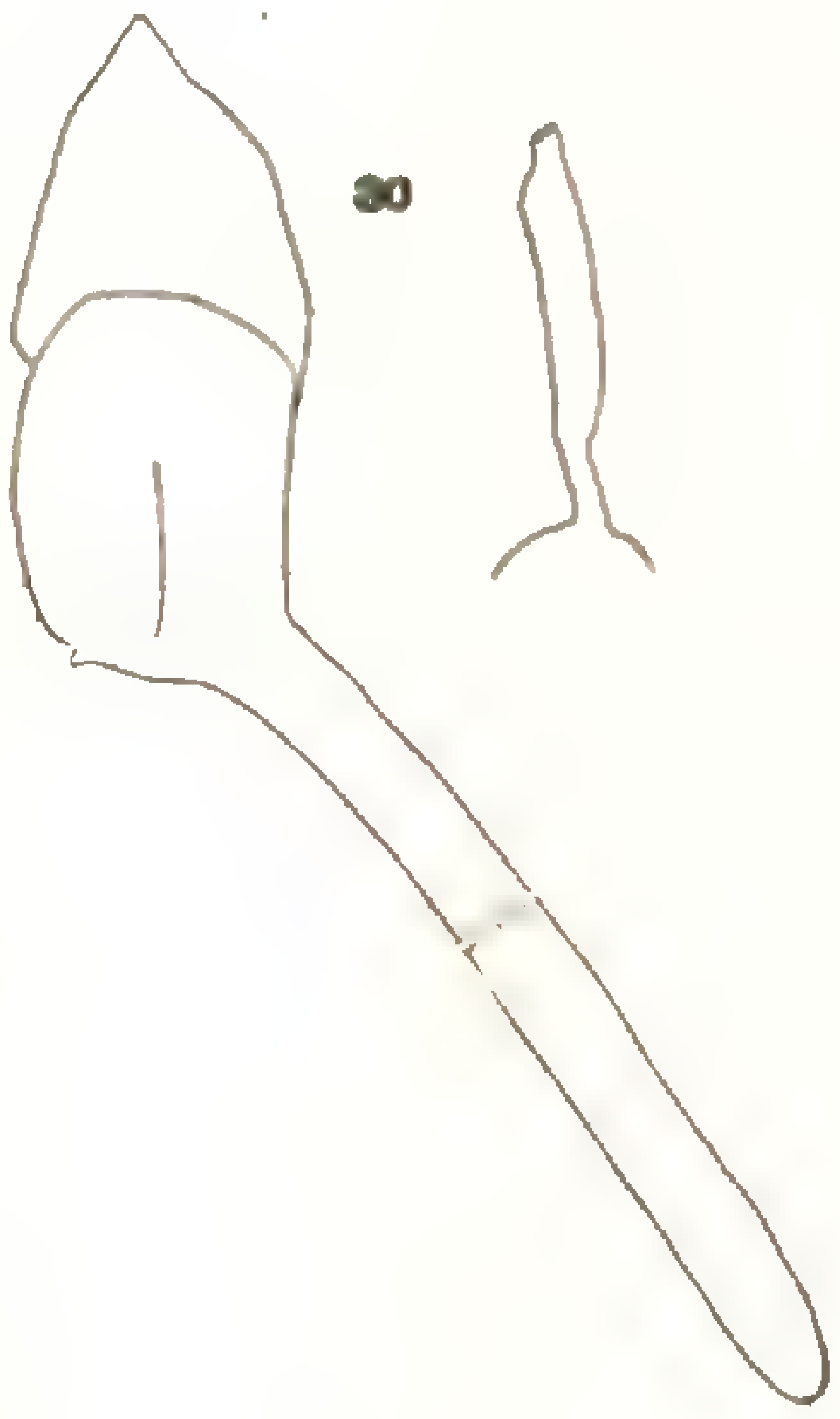
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(*b*) Spur 1.5 to 1.8 mm. wide at its widest portion: *V. delphinifolia* (Fig. 24), *V. odorata* (Fig. 25), *V. obliqua* (Fig. 26), *V. palmata* (Fig. 27), *V. sagittata* (Fig. 28) and *V. sororia* (Fig. 29).

E. In *V. rostrata* (Fig. 30) the length of spur is about 9 mm.

It will be seen that we have in this consideration the grouping of species of the genus into a number of natural groups which further study will no doubt justify. As to whether these groups include hybrids, or varieties of certain species, or each is deserving of the specific rank assigned to it further study alone will demonstrate. It is to be hoped that no more species will be described without a consideration of the morphological features of the genus indicated in this paper. The study of this genus by the author will be continued and he desires to acknowledge his indebtedness to Mr. C. D. Beadle, of Biltmore, N. C., and Mr. C. H. La Wall, of Philadelphia, for some of the material furnished for this investigation; and to Miss Florence Xaple, of Philadelphia, for assistance in certain parts of the work.

The common Parasite of the Powdery Mildews

BY DAVID GRIFFITHS

(PLATE 358)

AMPELOMYCES QUISQUALIS Ces. Bot. Zeitung **10**: 301. 1852.

Cicinobolus florentinus Ehr. Bot. Zeitung **11**: 16. 1853.

Bassocystis textilis Riess. Bot. Zeitung **11**: 236. 1853.

Cicinobolus cesatii DeBary, Morph. und Phys. der Pilze, **3**: 53–75. *pl. 6, 7.*

Cicinobolus oidii Tuck. Rabenhorst, Fungi Europaei, No. 2215.

Cicinobolus humuli Faut. Revue Mycol. **12**: 37. 1890.

Cicinobolus cotoneus Pass. Thuemen Mycotheca Universalis, **17**: No. 1668.

Cicinobolus uncinulae Faut. Roumeguere Fungi Selecti Galliae **43**: No. 6208.

Cicinobolus major Kell & Swingle, Herb. J. B. Ellis, **37**: No. 84.

This plant attracted my attention a number of years ago on account of its abundance; a subsequent study of it in the field and laboratory has revealed some interesting facts. Its abundance on the forms of *Erysiphe cichoracearum* growing on *Grindelia squarrosa* in the Northwest is very noticeable. My first collection of it at Aberdeen, South Dakota, was made in 1893, but on account of the entire absence of fruit in the host (*Erysiphe*), I was unable to make any specific determinations. Although a careful search for fruiting specimens was made in the same locality for the next five years none were found. The conidial stage occurred in abundance and it was almost invariably accompanied by the *Ampelomyces.* While in company with Mr. L. W. Carter in western South Dakota and northeastern Wyoming in 1897, I collected fine fruiting specimens of the *Erysiphe* at the "L. A. K." ranch in South Dakota and at Moorcroft, Wyoming. The former was unaffected by the fungus, while the latter had practically no perithecia in a healthy condition. The latter was as fine an illustration of parasitism as one could wish to see. There was at least one-half acre of the *Grindelia* on a small creek bottom growing as thick as it could well stand, and it would have been difficult to find any leaves in the whole patch that were unaffected with the *Erysiphe*; but none of it was able to produce mature perithecia on account of the depredations of its parasite. It would be interesting to know whether the conidial stage of the *Erysiphe* carries the plant over the winter season or whether the *Grindelia* becomes inoculated by the same species growing on other composites in the same locality. It is also interesting to compare this case with the propagation of the conidial stage of the grape mildew in European countries year after year without the intervention of the perithecial stage.

While in company with Mr. T. A. Williams in Wyoming and Montana in 1898, an abundance of this plant was found on *Grindelia squarrosa* and *Lygodesmia juncea*, especially in the vicinity of Buffalo, Wyoming, and Billings, Montana. The specimens collected at old Fort McKinney in Wyoming show the habits of the parasite the best of any which I have. The *Erysiphe* on the lower leaves is practically destroyed but that on the upper younger leaves produces perithecia in abundance. The *Ampelomyces* is easily recognized by its dusty appearance which gradually grades off into the characteristic white appearance of the mycelium of the host. In this intermediate region the pycnidia may be found in abundance which develop within the perithecia, and which consequently have a globular appearance. On the lower leaves the pycnidia are usually of the oval or pyriform type. This is easily accounted for from the fact that the *Ampelomyces* produced its pycnidia on the lower leaves at a time when there were no perithecia formed and did not spread as rapidly as the host. The same holds true in general of specimens collected near Buffalo, Wyoming, on *Lygodesmia juncea*, excepting that the areas affected by *Ampelomyces* are more localized and scattered.

Besides the synonymy given above two other species of this genus have been described, *i. e.*, *Cicinobolus plantaginis* Oud. and *C. parasiticus* (Cocc.) Sacc., specimens of which have not been seen and concerning which, consequently, no positive statements can be made. So far as the descriptions in Sylloge Fungorum are concerned, however, there is nothing to prevent both of these species being placed here.

Having included some characteristics of this species which, so far I am aware, have not been noted before, it may not be out of place to include the following description based on specimens from both Europe and America.

Mycelium variable, hyaline to fuscous, within the mycelium of species of Erysiphaceae and occasionally in the tissues of the host plant (Fig. 16), 4 to 8 (usually 4 to 5) μ in diameter; pycnidia very variable in size and form, membranous, oval, pyriform to globular, fuscous to brown, produced in horizontal mycelium (Fig. 8), conidophore (Fig. 1–7), or perithecium (Fig. 10–12); spores hyaline, oblong, often slightly inequilateral, biguttulate when mature, 6½–10½ × 3½–6 μ (Fig. 15).

There occurs in the various descriptions of this species, under different names, a wide variation in characteristics which in many groups would establish good species, and indeed might here were it not for the extreme variability of single specimens. In some cases the pycnidia have been described oval to pyriform and stipitate, and in other cases globular. The accompanying figures will clear away all doubt regarding the possibility of such a variation and explain how it occurs. In my specimens on *Grindelia* a variation of fifty μ in size of the perithecia may often be found in the same microscopic field. A great discrepancy also occurs in the measurement of spores by various observers; when, however, the specimens from which these measurements were made are compared with one micrometer scale they are reduced to the limits easily attained in any species. Descriptions vary also in the matter of guttulation of the spores, some being described as guttulate and others as continuous. My specimens on *Grindelia* and *Lygodesmia* show both of these conditions in different stages of development. When mature the spores always show the characteristic guttulae. One may, by squeezing young pycnidia under the cover slip, see small, oval, globular or irregular continuous cells. A study of De Bary's figures of the spore development will easily show that these are nothing more than the young spores imperfectly formed, or in some cases simply cells of the pycnidia. In examining some of the herbarium material at hand, especially European exsiccati, this phenomenon was often met with. Careful examination of my own material collected early in the season showed the same peculiarity; and in some exsiccati, notably *Cicinobolus cotoneus* Pass., both mature and immature pycnidia were common.

HOSTS EXAMINED

Oidium cydoniae Pass. parasitic on *Cydoniae vulgaris* Pers.

Oidium erysiphoides Fr. (*Sphaerotheca humuli* (DC.) Burrill?) parasitic on *Humulus* sp.

Oidium Tuckeri Berk. (*Uncinula necator* (Schw.) Burrill?) parasitic on *Vitis vinifera* L.

Sphaerotheca phytoptophila K. & S. parasitic on *Celtis occidentalis* L.

Sphaerotheca Castagnei Lev. parasitic on *Bidens cernua* L.

Conidial stage of Erysiphaceae, parasitic on *Cynoglossum* sp.

Erysiphe communis (Walk.) Fr. parasitic on *Pisum sativum* L.

Erysiphe cichoracearum DC. parasitic on *Grindelia squarrosa* Dounal and *Lygodesmia juncea* Don.

Sphaerotheca Castagnei Lev. parasitic on *Collomia linearis* Nutt. and *Epilobium adenocaulon* Haus.

Phyllactinia suffulta (Reb.) Sacc. parasitic on *Crataegus rivularis* Nutt.

Microphaera alni (DC.) Wint. parasitic on *Lonicera glaucescens* Rydb.

REFERENCES

Bot. Zeitung. **10**: 301, 1852; **11**: 16, 236, 1853. DeBary, A. Morphologie und Biologie der Pilze, **3**: 53–75, *pl. 6, 7*. De Bary, A. Morphology and Biology of the Fungi, Mycetozoa and Bacteria, 247, *f. 119*. Saccardo, P. A. Syll. Fung. **3**: 216, **10**: 220, **11**: 502. Flora, **35**: 397. 1852. Schenk, Handbuch der Botanik **4**: 324–327, 544. 1890. Ellis and Everhart, North American Pyrenomycetes 3, 4, 1892. Leunis and Frank, Synopsis der Pflanzenkunde, **3**: 353, *f. 94*. 1886. Tulasne, Selecti Fung. Carp. **1**. Oestr. Wochenb. **14**: 126–128, 1888. Revue Mycol. **12**: 73, 176, 1890; **15**: 16, 69, 1893. Hedwigia, **1**: 23, 1852.

EXSICCATI EXAMINED

Roumeguere, Fungi Selecti Galliae, nos. 6107, 6108, 5461, 6207, 6208. Sydow. Mycotheca Marchica, no. 1537. Rabenhorst, Fungi Europae, no. 2215. Krieger, Fungi Saxon, no. 987. Thuemen. Mycotheca Universalis, no. 1668.

Explanation of Plate 358

1. Pycnidium produced in conidiophore on *Grindelia*. All remains of the conidiophore have disappeared, but the mycelium of *Ampelomyces* can be seen within the mycelium of the *Erysiphe*.

2. The same with the remains of the conidiophore.

3. Pycnidium of *C. cotoneus* Pass. (Thuemen, Mycotheca Universalis, no. 1668).

4. Pycnidium on *Grindelia*.

5. Pycnidium of *C. humulis* Faut. from duplicate of the original material (Roumeguere, Fungi Sel. Gal. no. 5461).

6. Pycnidium evidently developed in the upper part of a conidiophore on *Lygodesmia juncea*.

7. Pycnidium of *C. uncinulae* Faut. from duplicate of the original material (Roumeguere, Fungi Sel. Gal. no. 6208).

8. Pycnidium developed within the horizontal mycelium threads on *Grindelia*.

9. Young pycnidium on *Lygodesmia juncea*.

10. Young pycnidium developing within a large perithecium on *Grindelia*.

11. Pycnidium within a smaller perithecium. The wall of the perithecium has almost disappeared. Some of the appendages contain the mycelial threads of the fungus.

12. Pycnidium developed within the perithecium, the perithecium having entirely disappeared. The appendages will be easily recognized as a development of the mycelium within the appendages as seen in 11.

13 and 14. Mycelium of *Ampelomyces* within the mycelium of *Erysiphe cichoracearum* on *Lygodesmia juncea*, the mycelium of the former growing into the haustoria of the latter.

15. Spores from specimen on *Grindelia*.

16. Mycelium of *Ampelomyces* within the leaf hairs of *Cydonia vulgaris* Thuemen's Myc. Univ. no. 1668).

NOTE.—All drawings magnified 270 diameters except no. 10, which is magnified 190 diameters.

COLUMBIA UNIVERSITY, 1 March, 1899.

An Enumeration of the Plants collected by Dr. H. H. Rusby in South America, 1885–1886.—XXVII

By H. H. Rusby

(Continued from Bull. Torr. Bot. Club, **26**: 152. 18 Mr. 1899.)

Solanum dibrachiatum Van Huerck & Muell.Arg. in Huerck Obs. Bot. 59 (no. 836). The same as Spruce's 4250 and 4051 (sub "*S. monadelphum*").

Solanum lycioides L. Mant. **1**: 46. Sorata, 8000 ft., February, 1886 (no. 803).

Solanum mammosum L. Sp. Pl. 187. 1753. Mapiri, 2500 ft., May, 1886 (no. 789).

Solanum Mandonis Huerck et Muell.Arg. in Huerck Obs. Bot. 78. Yungas, 6000 ft., 1885 (no .782). The same as Mandon's 425 and Bang's 2619.

Solanum nigrum L. Sp. 186. Tacna, March, 1885 (no. 832). and Unduavi, 8000 ft., October, 1885 (nos. 802 and 2642).

Solanum nudum H. & B. Dun. Solan. Syn. ed. 2, 20. *pl. 107.* Vic. La Paz, 10000 ft., Apr., 1885 (no. 785) and Yungas, 4000 ft. 1885 (no. 769).

Solanum ochrophyllum Van Huerck et Muell. Arg. in Huerck Obs. Bot. 50. Unduavi, 10000 ft., Oct., 1885 (no. 777). The same as Bang's 1630 and 1931.

Solanum pallidum Rusby, Mem. Torr. Bot. Club, **4**: 228. Sorata, 8000 ft., Feb., 1886 (nos. 787 and 811).

Solanum Pearcei Britton ex Rusby, Mem. Torr. Bot. Club, **4**: 227. Unduavi, 8000 ft., Oct., 1885 (no. 794).

Solanum polytrichum Moric. Nouv. Amer. 32. *pl. 22.* Mapiri Apr. and May, 1886 (nos. 783 and 793).

Solanum pterocladum Van Huerck et Muell. Arg. in Huerck Obs. Bot. 44. Sorata, 8000 ft., Feb., 1886 (no. 781). The same as Mandon's 415 and Bang's 2872.

Solanum pulverulentum Pers. Syn. **1**: 223. Vic. La Paz, 10000 ft., Apr., 1885 (no. 797).

Solanum pycnanthemum Mart. Flora **20**: 11 Beibl. 120. 1837. Guanai, 2000 ft., May, 1886 (no. 775).

Solanum radicans L. f. Dec. **1**: 19. *pl. 10.* Sorata, 8000 ft., Feb., 1886 (no. 808) and Vic. La Paz, 10000 ft., Apr., 1885 (no. 807). Prostrate, widely branching.

Solanum sisymbrifolium Lam. Tabl. Encyc. **2**: 25. Yungas, 6000 ft., 1885 (no. 768).

Solanum sordidum Sendt. in Mart. Fl. Bras. **10**: 53. *pl. 4. f. 47–50.* Unduavi, 10000 ft., Oct., 1885 (no. 801).

Solanum ternatum R. & P. Fl. Per. **2**: 38. *t. 172.* Junction of Rivers Beni and Madre de Dios, Aug., 1886 (no. 810). Specimens in an undeveloped state.

Solanum ——— Dunal ex DC. Prod. **13**^{1}: 72. Sorata, 8000 ft., Feb., 1886 (no. 808), and vic. La Paz, 10000 ft., April, 1885 (no. 807).

Solanum velutissimum Rusby, Mem. Torr. Bot. Club, **6**: 89. Yungas, 6000 ft., 1885 (no. 2587).

Solanum violifolium Schott ex Spreng. Syst. **4**, Cur Post, 103, n. 5. Mapiri, 2500 ft., May, 1886 (no. 2678). Creeping widely.

Solanum Wrightii Benth. Flora Hongk. 243. Guanai, 2000 ft., May, 1886 (no. 791).

(Species novae, Sect. *Aculeatae.*)

Solanum hyoscyamifolium sp. nov.

Apparently herbaceous: prickles very few, yellow, 1 mm. long, stout, straight; densely and very finely gray stellate-tomentose, the upper leaf-surfaces green, shortly rough stellate-hairy: branches slender, weak: petioles 2–6 cm. long, thickish but weak: blades 6–12 cm. long, 3–12 cm. broad, ovate from a broad truncate base, abruptly acuminate and very acute, the margin bearing one to three pairs of very large acute teeth or small lobes, the sinuses broad and rounded, very thin, the veins lightly prominent underneath, broad and low: cymes appearing as though lateral from the middle of the internodes, their peduncles 2 or 3 cm. long, the flowering portion 2–4 cm. broad, rather dense: pedicels .5–1 cm. long in flower and young fruit, slender: calyx-bud ovoid, obtuse: corolla-bud 7 mm. long, 2 or 3 mm. broad, oblong-ovoid, blunt: calyx 3 or 4 mm. long, lobed two thirds of the way, the lobes ovate, acutish: corolla-tube short, the lobes 7 mm. long, ovate: anthers yellow, 6 mm. long, lance-linear, nearly straight, the pores looking upward and a very little inward: style 1 mm. longer than the stamens: the stigma of medium size: fruit not seen.

Junction of Rivers Beni and Madre de Dios, Aug., 1886 (no. 767).

Species very near *S. torvum* L.

Solanum Rusbyi Britton, sp. nov.

Strongly ferruginous: densely harsh-stellate, the upper leaf-surfaces less so, the fruit becoming glabrous: branchlets, petioles and peduncles densely prickly with long, slender, weak, rusty-red prickles, a few continued upon the principal veins on both surfaces: petioles 3 or 4 cm. long, very stout: blades 1–3 dm. long, .5–1.5 dm. broad, ovate, the rounded or sub-cordate base very inaequilateral, very short-pointed and acutish at the apex, very coarsely sinuate, thick, the venation sub-immersed above, prominent underneath; stout, angled, peduncle, and at length its similar branches, erect; branchlets numerous and cymes dense: pedicels stout, .5–1 cm. long: calyx-tube 4 mm. long, 6 mm. broad, the lobes 3 mm. long, nearly as broad, triangular-ovate, acute, the sinuses broad and rounded: corolla-bud 7 mm. long, 5 mm. broad, ovoid, the apex rounded: corolla-tube very short, the lobes 8 mm. long, 3.5 mm. broad, ovate: anthers (drying blackish) 5 mm. long, linear, nearly straight, the pores looking upward and a little inward: stigma but little exceeding the anthers: fruit purple-black, globose, more than 1 cm. in diameter. A stout shrub.

Unduavi, 10000 ft., Oct., 1885 (no. 799). The same as Bang's no. 1881, and (*fide* Britton) Mandon's no. 421.

Solanum myrianthum Britton, sp. nov.

Densely and shortly stellate-tomentose and gray, except the upper leaf-surfaces, which are dark-green and shortly stellate-hairy, and the fruit which is glabrous and shining: branches and petioles sparsely prickly, the prickles about 1 mm. long, stout, straight, yellow: branches somewhat woody, elongated, slender, flexuous, terete: petioles 1.5–3 cm. long, stoutish: blades 5–10 cm. long, 2–5 cm. broad, ovate, very inaequilateral at the base, somewhat acuminate and acutish at the apex, entire, thin: cymes short-peduncled, twice or thrice bifurcating, the branches at length 6–7 cm. long, slender, secund, loosely flowered, the pedicels horizontal or reflexed, in fruit 7–8 mm. long, little thickened upward: flowering calyx campanulate, 4 mm. long, the lobes 3 mm. long, ovate, acute, in fruit a little larger, mostly closely clasping the fruit: corolla-bud about 6 mm. long, 2.5 mm. broad, ovoid, the apex blunt: corolla (apparently violet) tube very short, the lanceolate lobes about 8 mm. long: anthers yellow, 5 mm. long, nearly straight, lance-linear, the pores looking inward, upward and slightly laterally: style decidedly longer than the anthers, thickened upward, the capitate stigma large: fruit red, globose, 6 mm. broad.

Junction of Rivers Beni and Madre de Dios, Aug., 1886 (no. 776). No. 809, from Guanai, 2000 ft., May, 1886, is apparently the same as is Bang's no. 2514.

The species is near *S. heterophyllum*, and apparently includes Jenman's no. 1125.

(Sec. *Inermes*.)

Solanum lilacinum sp. nov.

Unarmed, apparently herbaceous, sparsely stellate-pubescent, the lower leaf surfaces softly pubescent, pale or grayish, the upper strigose, roughish, dark-green: branchlets widely spreading, flexuous, angled: petioles 1–2 cm. long, narrowly margined above, weak; blades .5–1 dm. long, 3–5 cm. broad, ovate, acute, the base rounded to sub-truncate, slightly produced into the petiole, inaequilateral, entire-margined, thin: peduncles 2–4 cm. long: cymes 6–8 cm. broad, rather dense: pedicels slender, .5–1 cm. long, reflexed in fruit: calyx-tube turbinate, 2 mm. long and broad, 5-nerved, the lobes a little more than 1 mm. long, triangular-ovate, acutish, the sinuses larger, acute or obtuse: corolla light-blue, rotate or reflexed, 1–1.2 cm. broad, lobed about half way, the lobes triangular, acute: filaments slender, 1 mm. long, the anthers yellow, 3 mm. long, linear-oblong, straight, the pores large, looking inward and very slightly upward: style 2 mm. longer than stamens: the stigma slightly elongated: fruit dard-red (?) smooth, 5–6 mm. in diameter.

Unduavi, 8000 ft., Oct., 1885 (no. 779). Bang's no. 2023 seems to be a smoother form of the same, and Mandon's no. 409 appears to be of this species, though it differs greatly in the size of the leaves.

The species is very near *S. Gayanum* (Remy) Phil.

Solanum actaeabotrys sp. nov.

Indumentum stellate-tomentose, very dense and short, roughish, the upper leaf surface stellate-scabrous, the fruit glabrous: branches woody, stout, terete, flexuous: petioles (the upper only seen) 2.5 cm. long, 5 mm. thick: blades 1.5–2.5 dm. long, 1–1.5 dm. broad, ovate to oval, inaequilateral, especially at the rounded or subcordate base, blunt or rounded at the apex, entire or obscurely repand at the margin, thick, gray-ferruginous underneath, above ferruginous when young, becoming dark-green: cyme short-peduncled, twice bifurcating, the fruiting branches at length 1–1.5 dm. long, loosely fruited, in flower rather dense: pedicels stout, in flower very short, in fruit 1 cm. long and strongly thickened upward: calyx campanulate, 5–7 mm. long, the thick, triangular-ovate acute or acutish lobes appressed, 3 mm. long and broad, the sinuses of similar form and size: calyx-bud 6 mm. long, 4 mm. broad, obovoid with rounded apex: corolla-bud subglobose: corolla-tube very short, the lobes ovate: anthers 7 mm. long, lanceolate, incurved at the apex: fruit depressed-globose, 1.2 cm. broad in the dried and wrinkled condition, smooth and shining, apparently green at maturity.

Mapiri, 5000 ft., April, 1886 (no. 773).

A stout shrub, apparently in the *Aculeatae*, but prickles not found upon the specimen.

Species near *S. decorum*, also near to Lechler's no. 2118 from Peru and Mathew's no. 3252.

Solanum Lechleri sp. nov.

Unarmed, stellate-tomentose and gray, except the blackish fruits and the dark-green upper leaf-surfaces which are rather sparsely hairy, the hairs slightly stellate; branches herbaceous: petioles 1–2 cm. long, weak, narrowly margined above: blades 5–10 cm. long, 2.5–5 cm. broad, ovate from a broad, rounded to sub-truncate base, acuminate, acute, entire, thin, the venation sparse, slender and weak, crooked, pale, lightly prominent both sides: cymes terminal, on slender peduncles, in early flower 4 cm. broad, dense, the flowers drooping: pedicels 7–10 mm. long, weak and slender: calyx 4–5 mm. long, lobed two thirds of the way, the lobes herbaceous, ovate, acutish, the sinuses broadly triangular, acutish: corolla blue, a little more than 1 cm. broad when expanded, deeply lobed, the lobes broadly ovate, obtuse: anthers yellow, 3.5 mm. long, oblong, straight, the pores looking inward and slightly towards one another: style nearly twice the length of the anthers: the stigma small: fruit blackish, 7 mm. in diameter.

Yungas, 4000 ft., 1885 (no. 790). The same as Lechler's no. 1939 and (*fide* Britton) Mandon's no. 1106.

Solanum pseudo-lycioides sp. nov.

Glabrous and unarmed; branches whitish, numerous, bearing many short, divaricate, rigid and spine-like, at first leafy, branchlets an inch or two in length: leaves numerous, .5 to 2.5 cm. long, 2.5 to 5 mm. broad, oblong to oblanceolate, tapering into a very short petiole, obtuse, entire, pale, somewhat fleshy, 1-nerved, the veins inconspicuous, finely much wrinkled in drying: pedicels solitary at the ends of the short branchlets, very slender, about 1 cm. long, enlarging upward, where the green wing-angles become continuous with the sepals: calyx-tube turbinate, 4 mm. long and broad, bluish, with five broad herbaceous angles continuous with the foliaceous, narrowly ovate lobes, which are 2 or 3 mm. long: corolla blue, nearly 2 cm. broad: anthers 2 mm. long, .6 mm. broad, elliptical oblong, straight, the pores looking inward and slightly upward: fruit depressed-globose, 7 to 8 mm. broad, smooth, apparently green at maturity, the closely appressed shallowly crateriform calyx-tube 6 mm. broad, the lobes recurved.

Vic. La Paz, 10000 ft., Apr., 1885 (no. 833) and 12000 ft., Oct., 1885 (no. 835). The same as Bang's no. 32, published as *S. lycioides* L.

A rough much-branched shrub, abundant on the dry hills about La Paz.

Solanum psidiifolium sp. nov.

Branchlets and lower leaf-surfaces finely stellate-puberulent; branches woody, very stout, the internodes about 5 cm. long: petioles 1 to 1.5 cm. long, very stout and broad: blades 1.5 to 2 dm. long, .7 to 1 dm. broad, oval-ovate, the rounded base abruptly contracted into the margined petiole, apex not seen, entire, thick and coriaceous, midrib and about 12 pairs of slender secondaries lightly channelled above, prominent underneath: peduncles nearly 2 cm. long, stout, erect: cymes 2 or 3 cm. broad, loose: pedicels .5 to 1 cm. long, thickish but weak: calyx thick, 4 mm. long, 5 mm. broad, lobed about one third, the blackish tube hemispherical, the lobes nearly semicircular: corolla apparently white, very thick, nearly 1 cm. long, lobed nearly to the base, the lobes ovate: anthers 4 mm. long, broader at the summit, the very large pores looking laterally and inward: style stout, angled, 1 mm. longer than the stamens: fruit not seen.

Yungas, 4000 ft., 1885 (no. 2641). Mr. Bang's no. 2250, with oval-obovate leaves, rounded at the apex, appears to be the same.

Species near *S. Lindenii.*

Solanum (?) volubilis sp. nov.

Stellate-puberulent, the upper leaf surfaces granular; branches much elongated, slender, very flexuous, climbing by the curved petioles, which are 2–3 cm. long, stoutish, lightly channelled above: blades 4–8 cm. long, 2–6 cm. broad, ovate, cordate with a broad shallow sinus, short-pointed and acute, entire, thickish, pale-green, the venation slender, little prominent: cymes loosely panicled at the summit, long-peduncled, the branches sub-circinate, somewhat secund: pedicels about 3–5 mm. long, stout, thickened upward, lightly angled: calyx crateriform, loosely embracing the bud, 5 mm. broad, thickish, lobed about one third of the way, the lobes very broad and obtuse: corolla bud 1 cm. long, ovoid with rounded apex: corolla bluish, divided nearly to the base, the lobes linear-lanceolate, thickish, obtusish: anthers 8 mm. long, narrowly lanceolate, brown, the small pores looking inward and a little laterally: style pubescent, stout, a little longer than the stamens: the stigma rather small: fruit (dark-red?) smooth, globose, about 6 mm. in diameter.

Junction of Rivers Beni and Madre de Dios, August, 1886 (no. 839).

The plant has the habit and general appearance of a *Cyphomandra* but not the connectives.

Cyphomandra Fraxinella Sendt. in Mart. Flor. Bras. **10**: 122. Guanai, 2000 ft., May, 1886 (no. 800).

Cyphomandra betacea (Cav.) Sendt. in Flora **28**: (1845) 172. (*Solanum betacea* Cav. Anal. Hist. Nat. **1**: (1799) 44; Ic. **6**: 15 *t. 524.*). Falls of Maderia, Brazil, Oct., 1886 (no. 805).

Cyphomandra Yungasense sp. nov.

Inflorescence and younger portions minutely pubescent branches elongated, slender, strongly angled, apparently climbing by the twisted petioles, which are 2–3 cm. long, slender, channeled above: blades 1–1.5 dm. long, 5–7 cm. broad, ovate, lightly cordate, abruptly short-acuminate and acute, entire, very thin, deep green: inflorescence terminal, paniculate, the panicle open, loose, the flowers pendulous: pedicels about 1 cm. long, stout, angled, slightly thickened upward: calyx 5 mm. long, about 7 mm. broad, hemispherical-campanulate, thickish, shallowly 5-lobed, the lobes broad and rounded at the summit: corolla (violet?) 1.5–2 cm. long, deeply lobed: anthers yellow, 7 mm. long, the connectives little thickened, the pores very small, looking upward and inward.

Yungas, 6000 ft., 1885 (no. 2475).

Near *C. floribunda* Miers.

Cyphomandra acuminata sp. nov.

Glabrate; branches much elongated, stout, terete, drying blackish; petioles 2–3 cm. long, rather slender, sub-terete, narrowly channeled: blades 6–15 cm. long, 3.5–7 cm. broad, ovate, cordate, regularly acuminate and acute, entire, thickish, rigid, when young minutely puberulent, especially underneath, the venation sparse and slender, secondaries about 7 irregular pairs: peduncles 4–6 cm. long, slender, dichotomous, the scorpioid branches simple, slender, .8–1.2 dm. long, strongly nodose from the fallen flowers, which are about 3–5 mm. apart: pedicels 1–1.5 cm. long, slender: calyx 6 mm. long, slightly broader, campanulate-turbinate, shallowly 5-lobed, the lobes broad, rounded, abruptly short-pointed: corolla purple, 1.5 cm. long, lobed nearly to the base, thickish, the lobes lanceolate, acuminate and acute, strongly recurved: anthers 5 or 6 mm. long, ovate, somewhat curved, purple within, dark on the back, the large pores looking inward, upward and laterally: style little exceeding the stamens, very stout: the stigma peltate, 2 mm. broad: fruiting pedicel greatly thickened, especially at the summit: fruit (mature?) subglobular, yellow, smooth, 4 cm. in diameter.

Yungas, 6000 ft., 1885 (no. 2600). The same as Bang's no. 2281, which has larger leaves.

Cyphomandra Benense Britton, sp. nov.

Closely puberulent; branches rather short, pale green, terete or somewhat coarsely angled: petioles .5–1.5 cm. long, rather weak, sub-terete, narrowly channelled above: blades .5–1 dm. long, 2.5–5 cm. broad, ovate-oval, the base truncate or slightly cordate, acuminate and acute at the apex, entire, thin and flaccid, pale grayish-green, the venation weak and inconspicuous: cymes scorpioid-racemose, short-peduncled, .5–1 dm. long, simple and bifurcated, slender, strongly nodose from the fallen flowers, which are 2 or 3 mm. apart: pedicels slender, about 1 cm. long: calyx about 4 mm. long, the tube very short, the lobes broadly ovate, acute, herbaceous: corolla (violet) 1 cm. long, deeply lobed, the lobes ovate, acuminate, acutish: anthers 4.5 mm. long, ovate, the connective rather narrowly thickened and backwardly arched, and slightly extended basally: style slightly exceeding the stamens, stout: stigma capitate, large: fruit not seen.

Junction of Rivers Beni and Madre de Dios, Aug., 1886 (no. 1840).

Physalis Peruviana L. Sp. Pl. ed. 2, 1670, Unduavi, 8000 ft., Oct., 1885 (no. 824).

Physalis margaranthoides sp. nov.

Glabrous; stems weak, coarsely angled, flexuous, the branchlets very slender, widely spreading: petioles .5–1 cm. long, very narrowly margined, weak: blades 2–5 cm. long, 1–2 cm. broad, ovate, slightly inequilateral, the base rounded but slightly produced into the petiole, short-pointed and acute at the apex, distantly, irregularly and rather obscurely dentate, the short broad teeth mostly acute, very thin and flaccid, dark-green, the venation slender and inconspicuous both sides, the midrib slightly impressed above: pedicels in flower 3 mm., in fruit nearly 1 cm. long, very slender: calyx in flower 4 mm. long, lobed three fourths of the way, the lobes triangular-ovate, acuminate and acute, in fruit 2 to 2.5 cm. long, broadly ovate, little if at all pointed: corolla about 6 mm. long, light-yellow, almost equaled by the stamens: material for dissection wanting.

Junction of Rivers Beni and Madre de Dios, Aug., 1886 (no. 823). The same collected by Holton at Puerto Ocaña, Sept. 6, 1852.

Species near *P. Lagascae* R. & P.

Saracha diffusa Miers Illustr. So. Am. Pl. **2**: 17. Sorata, 8000 ft., Feb., 1886 (no. 831). The same as Mandon's 430.

Bassovia inaequilatera Rusby, Mem. Torr. Bot. Club, **6**^{1}: 90. Mapiri, 2500 ft., May, 1886 (no. 765).

Bassovia anceps (R. & P.) (*Solanum anceps* R. & P. Fl. Per. **2**: 36. *t. 169. f. a*). Yungas, 6000 ft., 1885 (no. 766). The same as Bang's nos. 2513, 2526 and (?) 1210.

Bassovia Fendleri sp. nov.

Branches slender, flexuous, terete, grayish-brown or yellowish-brown, very sparingly hairy upon the younger portions, the branchlets recurved or drooping: principal leaves sub-petioled by the very short narrowed base, 8–18 cm. long, 3–6 cm. broad, very inequilateral, rhomboidally oblong-lanceolate, the base sub-cuneate and then abruptly short-produced, the apex abruptly contracted and then attenuate, thin and membranous, bright-green: principal veins 10–12 on the large side, sparsely strigose above, glabrous below, except the veins, which are appressed-hirsute both sides: reduced leaves of similar texture and form, or slightly broader and scarcely pointed, 2–3 cm. long, slightly reflexed: cymes 3–4-flowered, the pedicels unequal, the longer, in flower, 1 cm. long, slender, strongly thickened upward, mostly reflexed: calyx conical-campanulate, 4–5 mm. long, the truncate border bearing

10 linear subulate teeth one half to two thirds as long as the tube: corolla-lobes at length reflexed, 6–7 mm. long, lance-linear, acute: anthers 3 mm. long, ovate, straight, the base minutely caudate, one half longer than their filaments: style filiform, 5–6 mm. long: stigma oblong: fruit not seen.

Yungas, 6000 ft., 1885 (no. 770).

Brachistus hebephyllus Miers in Am. and Mag. Nat. Hist. Ser. II, **3** (1849) 266. Yungas, 4000 ft., 1885 (no. 805). The same collected by Gondob in New Granada.

Brachistus lasiophyllus (Humb. et Bonp.) (*Solanum lasiophyllum* Humb. et Bonp. ex Dunal Solan. Syn. 25). Yungas, 6000 ft., 1885 (no 2697). The same as Bang's no. 2617.

Brachistus hispidus sp. nov.

Hispid throughout, except the mature fruit (corolla not seen), with mostly scattered, long white hairs which are branched at the summit: petioles 2–3 cm. long, rather slender, broadly channelled above, blackish, dilated at the base: blades .6–1.2 cm. long, 4–6 cm. broad, ovate, rounded at the base, abruptly short-acuminate and very acute at the apex, entire, thin, dark-green, below sparsely (except densely on the prominent principal veins), and above very sparsely hairy: flowers not seen: fruiting pedicels solitary, 3 cm. long, stoutish, angled, slightly thickened at the summit: fruiting calyx-tube 5 mm. long, 1 cm. or more broad, crateriform, the border sinuately 10-lobed and the lobes terminating in linear attenuate teeth nearly 1 cm. long: entire calyx strongly hispid: fruit (blackish) elongated globular, about 1 cm. long.

Guanai, 2000 ft., May, 1886 (no. 2524).

Brachistus strigosus sp. nov.

Strigose throughout, for the most part densely, including the outer surface of the corolla; branches woody, elongated, flexuous: petioles proper 5 mm. long, margined, broad: blade 3–9 cm. long, 2–4 cm. broad, very inaequilateral, oblong or oval, acute at the base and narrowed into the petiole, narrowly acuminate and acute at apex, entire, thin, yellowish-green, the venation lightly prominent, both sides, indumentum light yellow: pedicels fascicled, about 1 cm. long, slender, slightly thickened upward: calyx-tube hemispherical in flower, 3.5 mm. broad, the narrowly linear dark teeth about 1.5 mm. long: corolla (violet?) nearly 1.5 cm. broad, the 10 lobes narrowly ovate, acuminate: anthers yellow, nearly 4 mm. long, ovate, the back outwardly arched below, the base shortly and bluntly sagittate: style 2 mm. longer than stamens, dark, stout, gradually thickened into the lighter, rather small stigma: only very young fruit seen, this globular.

Yungas, 6000 ft., 1885 (no. 786).

Brachistus leptocaulis sp. nov.

Leaves and younger portions minutely stellate; branches woody, elongated, slender, flexuous, whitish, angled, the branchlets very short: petioles 2–3 mm. long, margined: blades 2–5 cm. long, 1–2 cm. broad, lance-oblong or ovate-oblong to obovate, narrowed into the petiole, acute, entire, light-green, very thin and flaccid: pedicels solitary at the ends of the branchlets, 1 cm. or more long, weak: calyx-tube 4 mm. long, 5 mm. broad, hemispherical, the 10 linear lobes 4 mm. long, elongating with age: corolla nearly 1 cm. long, apparently yellowish-purple, narrowly 5-costate: fruit not seen.

Guanai, 2000 ft., May, 1886 (no. 2657).

Dunalia lycioides Miers in Hook. Lond. Journ. Bot. **7**: (1848) no. 338. Vic. La Pez, 11000 ft., Apr., 1885 (nos. 827 and 828) Sorata, 8000 ft., Feb., 1885 (no. 829). Also seen near Tacna, 6000 ft. A densely growing shrub 6–10 ft. high, the flowers dark blue.

Poecilochroma albescens Britton ex Rusby, Mem. Torr. Bot. Club, **6**: 91. Unduavi, 10000 ft., Oct., 1885 (no. 2564).

Poecilochroma punctata (R. & P.) Miers in Hook. Lond. Journ. Bot. **7**: (1848) 324. Unduavi, 8000 ft., Oct., 1885 (no. 834). No. 2474 from Vic. La Pez, 10000 ft., Apr., 1885, may be the same, though the leaves are much smaller.

Salpichora glandulosa Miers, Hook. Lond. Journ. Bot. **4**: (1845) 325. Unduavi, 10000 ft., Oct., 1885 (no. 1935).

Salpichroa diffusa Walp. Ann. **3**: 169. Vic. La Pez, 10000 ft., Apr. 1885 (no. 830).

Solandra Boliviana Britton, sp. nov.

Glabrous; stems softly and weakly shrubby, procumbent in decaying forest material, much wrinkled in drying, pale, the branchlets a few centimeters long, very thick, closely beset with the nodose bases from which the petioles have disarticulated, these 3 or 4 mm. broad, slightly concave: petioles 5–8 mm. long, slender, slightly channelled: blades 4–7 cm. long, 1.5–3 cm. broad, regularly obovate, acute at the base, abruptly very short-pointed and obtuse at the apex, entire, thick, dark above, pale underneath: flowers solitary at the ends of the branchlets, sub-sessile: bracts nearly 5 cm. long, nearly 2 cm. broad, oval or obovate, narrowed at the base, acutish or obtuse, obscurely 3–5-nerved: narrow portion of the blue-purple corolla-tube about 6 cm. long, .5–1 cm. broad, the dilated portion about the same length, as pressed, 4 cm. broad at the summit, campanulate, the spreading or reflexed margin nearly 3 cm. broad, variously lacerate: stamens reaching the mouth of the corolla, the light-yellow anthers 1 cm. long, 4 mm. broad: style extending nearly 1.5 cm. beyond the stamens, gradually dilated at the summit into the 2-lobed stigma, which is 4 mm. broad: fruit not seen.

Yungas, 6000 ft., 1885 (no. 1155). Scarce and apparently flowering infrequently.

Iuanulloa Mexicana (Schlecht.) Miers in Ann. and Mag. Nat. Hist. Ser. II., **4**: (1849) 188 (*Lauresia Mexicana* Schlecht, in Linnaea **8**: (1833) no. 513). Mapiri, 2500 ft., May, 1886 (2598).

Cestrum calycinum Willd. and Schlecht. in Linnaea **7**: (1832) 64. Guanai, 2000 ft., May, 1886 (nos. 815 and 817).

Cestrum Parqui L'Her. Stirp. Nov. 73. Near Valparaiso, Chili, June, 1885 (no. 812). No. 820 from La Paz, 10000 ft., April, 1885, and no. 819 from Sorata, 8000 ft., February, 1886, may be of this species, though more likely *C. euanthes* Schlecht. in Linnaea **7**: (1832) 60.

Cestrum floribundum Britton ex Rusby, Mem. Torr. Bot. Club, **6**: 92, Junc. of Rivers Beni and Madre de Dios, Aug., 1886 (no. 818).

Cestrum coriaceum Miers in Hook. Lond. Journ. Bot. **5**: (1846) 161. Yungas, 6000 ft., 1885 (no. 814). The same as Holton's no. 607, Bang's no. 2465, Burchell's no. 7262 and a specimen collected by Triana at Bogota.

Index to recent Literature relating to American Botany

Anderson, A. P. Diseases of plants. Bull. S. C. Exper. Sta. 36: 1–16, *f. 1–14.* S. 1898.

Anderson, A. P. The Asparagus Rust in South Carolina. Bull. S. C. Agric. Exper. Sta. 38: 1–15. *f. 1–5.* F. 1899.

Ashe, W. W. The dichotomous Group of *Panicum* in the Eastern United States. Jour. Elisha Mitchell Sci. Soc. **4**: 22–62. F. 1899.
Includes new species.

Averill, C. K. Stations for some of the rarer Plants of Connecticut. Rhodora, **1**: 39, 40. F. 1899.

Bessey, E. A. The comparative Morphology of the Pistils of the Ranunculaceae, Alismaceae, and Rosaceae. Bot. Gaz. **26**: 297–312. *pl. 25.* N. 1898.

Bissell, C. H. *Goodyera repens*, var. *ophioides*, in Connecticut. Rhodora, **1**: 40. F. 1899.

Bitter, G. Ueber das Verhalten der Krustenflechten beim Zusammentreffen ihrer Ränder. Jahrb. wiss. Bot. **33**: 47–127. *f. 1–14.* 1898.

Bode, G. Zur Reindarstellung des Chlorophyls. Bot. Centralb. **77**: 81–87. 13 Ja. 1899.

Boirivant, M. A. Recherches sur les Organes de Remplacement chez les Plantes. Ann. Sc. Nat. VIII. **6**: 309–400. *pl. 18–21.* 1898.

Brainerd, E. The Saniculas of western Vermont. Rhodora, **1**: 7–9. Ja. 1899.

Campbell, D. H. Recent Work upon the Development of the Archegonium. Bot. Gaz. **26**: 428–431. D. 1898.

Chamberlain, C. J. The Homology of the Blepharoplast. Bot. Gaz. **26**: 431–435. D. 1898.

Chester, F. D. Soil Bacteria in their Relation to Agriculture. Part I. Bull. Del. Exper. Sta. 40: 1–16. 1898.

Churchill, J. R. Some Plants about Williamstown. Rhodora, **1**: 24–26. F. 1899.

Collins, F. S. A case of *Boletus* poisoning. Rhodora, **1**: 21–23. F. 1899.
Poisoned by *B. miniato-olivaceus sensibilis.*

Coombe, J. N. The Reproduction of Diatoms. Journ. Roy. Micros. Soc. **1899**: 1–5. *pl. 1, 2.* F. 1899.

Copeland, E. B. A new self-registering Transpiration Machine. Bot. Gaz. **26**: 343–348. N. 1898.

Davis, J. J. A graminicolous *Doassansia.* Bot. Gaz. **26**: 353–354. N. 1898.

Doassansia Zizaniae sp. nov.

Eriksson, J. Étude sur le *Puccinia ribis* DC. des groselliers rouges. Rev. Gen. de Bot. **10**: 497–506. *pl.* 20. 15 D. 1898.

Fernald, M. L. A spurless *Halenia* from Maine. Rhodora, **1**: 36, 37. F. 1899.

Halenia deflexa heterantha, var. nov.

Fernald, M. L. The Rattlesnake-Plantains of New England. Rhodora, **1**: 2–7. *pl.* 1. Ja. 1899.

Includes 4 species.

Guerin, P. A propos de la presence d'un Champignon dans l'Ivrarie (*Lolium temulentum* L.). Jour. de Bot. **12**: 384–385. 1 D. 1898.

Guerin, P. Structure particuliere du Fruit de quelques graminées. Jour. de Bot. **12**: 365–374. 1 D. 1898. [Illust.]

Guignard, L. Les centres cinetiques chez les vegetaux. Ann. des Sc. Nat. **6**: 177–215. *pl. 9–12.* 1898.

Henderson, L. F. Twelve of Idaho's Worst Weeds. Bull. Idaho Exper. Sta. 14: 90–136. *pl. 13. f. 5.* 1898.

Hennings, P. Die Gattung *Diplotheca* Starb., sowie einige interessante und neue, von E. Ule gesammelte Pilze aus Brasilien. Beiblatt zur Hedwigia, **37**: (205, 206). 31 D. 1898.

New species in *Diplotheca, Aecidium* and *Uredo.*

Hennings, P. Fungi Americani-boreales. Hedwigia, **37**: 266–272. 25 O. 1898; 273–276. 31 D. 1898.

New species in *Ustilago, Uromyces, Puccinia, Phragmidium, Aecidium, Uredo Tylostoma, Cyathus, Patellaria, Darluca,* and *Camarosporium.*

Hennings, P. Fungi Jamaicenses. Hedwigia, **37**: 277–282. 31 D. 1898.

New species in *Puccinia, Ravenelia, Uredo, Aecidium, Polyporus, Polystictus, Daedalea, Phyllosticta* and *Cercospora.*

Hough, W. The environmental Interrelations in Arizona. Am. Anthropologist, **11**: 133–155. 1898.

Ecology of Arizona; list of 173 species of plants utilized by the Hopi Indians.

Hue, A. M. Revue des Travaux sur la Description et la Geographie des Lichens publies en 1894–1897. Rev. Gen. de Bot. **10**: 125–128. 15 Mar. 1898; 171–176, 15 Ap. 1898; 215–224, 15 My. 1898; 267–272, 15 Je. 1898; 313–320, 15 Jl. 1898; 345–352, 15 Ag. 1898; 381–384, 15 S. 1898.

Hyams, C. W. Medicinal Plants in North Carolina. Bull. N. C. Exper. Sta. 150: 330–410. Je. 1898.

Janczewski, E. de. Études morphologiques sur le genre *Anemone* L. Chapitre quatrième: La Tige. Rev. Gen. de Bot. **10**: 433–446. *pl. 16, 17.* 15 N. 1898; 507–518. *pl. 18–19.* 15 D. 1898.

The preceding three chapters will be found in earlier volumes.

Kirchner, W. C. G. Contribution to the fossil Flora of Florissant, Colorado. Trans. Acad. Sci. St. Louis, **8**: 161–188. *pl. 11–15.* 10 D. 1898.

Kolkwitz, R. Ueber den Einfluss des Lichtes auf die Athmung der niederen Pilze. Jahrb. wiss. Bot. **33**: 128–165. *pl. 1–2.* 1898.

Krasser, F. Zur Kenntniss des *Lycopodium cernuum.* Verhandl. k. k. zool.-bot. Gesellsch. Wien. **48**: 688–693. 30 Ja. 1899.

Le Jolis, A. Protestation contre le *Revisio generum Plantarum.* III$^{\text{II}}$. Jour. de Bot. **12**: 320–330. 1 N. 1898.

Magnus, P. Ueber die von O. Kuntze vorgenommenen Aenderungen der Namen einigen Uredineen-Gattungen. Bot. Centralb. **77**: 2–10. 28 D. 1898.

Magnus, P. Ueber einen in Südtirol aufgetretenen Mehlthau des Apfels. Ber. deutsch. Bot. Gesell. **16**: 331–334. *pl. 21.* 28 D. 1898.

Manning, W. H. *Matricaria discoidea* in Eastern Massachusetts. Rhodora, **1**: 18. Ja. 1899.

Meehan, T. *Chimaphila maculata.* Meehan's Month. **9**: 1–2. *pl. 1.* Ja. 1899.

Morse, W. F., & Howard, C. D. Poisonous Properties of wild Cherry Leaves. Bull. N. H. Exper. Sta. **56**: 112–123. *f. 6.* Au. 1898.

Nelson, A. The Trees of Wyoming and how to know them. Bull. Wyo. Exper. Sta. 40: 59–110. Ja. 1899. [Illust.]

Lloyd, F. E. On hypertrophied Scale-Leaves in *Pinus ponderosa.* Ann. N. Y. Acad. Sci. **11**: 45–51. *pl. 1.* Ap. 1898.

Minden, M. von Beiträge zur anatomischen und physiologischen Kenntniss Wasser-secernierender Organe. Bibliotheca Bot. **46**: 1–76. *pl. 1–7.* 1899.

Nordhausen, M. Beiträge zur Biologie parasitärer Pilze. Jahrb. f. wiss. Bot. **33**: 1–46. 1898.

Pollard, C. L. Further Observations on the Eastern acaulescent Violets. Bot. Gaz. **26**: 325–342. N. 1898.

Viola insignis sp. nov. figured. *V. primulaefolia australis* n. var.

Powell, G. H. The European and Japanese Chestnuts in the Eastern United States. Bull. Del. Exper. Sta. 42: 1–36. *f. 1–12.* D. 1898.

Prunet, M. A. Recherches sur le Black Rot de la Vigne. Rev. Gen. de Bot. **10**: 129–141. 15 Ap. 1898; 404–422. *pl. 21.* 15 O. 1898.

Rehm, H. Beiträge zur Pilzflora von Sudamerika. V. Hysteriaceae. Hedwigia, **37**: 296–302. *pl. 9.* 31 D. 1899.

New species in *Schizothyrium, Aulographium, Glonium, Hysterium, Gloniella* and *H sterostomella.*

Rehm, H. Beiträge zur Pilzflora von Südamerika. VI. Microthyriaceae. VII. Coryneliaceae. Hedwigia, **37**: 321–328. *f. 1–16.* 31 D. 1898.

New species in *Clypeolum, Seynesia* and *Micropeltis.*

Rich, W. P. *Amphicarpaea Pitcheri* in New England. Rhodora, **1**: 27, 28. F. 1899.

Riddle, L. C. The Embryology of *Alyssum.* Bot. Gaz. **26**: 314–324. *pl. 26–27.* N. 1898.

Robinson, B. L. A new wild Lettuce from Eastern Massachusetts. Rhodora, **1**: 12, 13. *pl. 2.* Ja. 1899.

Lactuca Morssii sp. nov.

Robinson, B. L. Fairy rings formed by *Lycopodium inundatum.* Rhodora, **1**: 28–30. F. 1899.

Rolfs, P. H. Diseases of the Tomato. Bull. Fla. Exper. Sta. 47: 117–153. *pl. 2.* S. 1898.

Rowlee, W. W., & Hastings, G. T. The Seeds and Seedlings of some Amentiferae. Bot. Gaz. **26**: 349–353. *pl. 29.* N. 1898.

Sablon, L du. Recherches sur les Reserves Hydrocarbonées des Bulbes et des Tubercules. Rev. Gen. de Bot. **10**: 353–369. 15 S. 1898. 385–403. 15 O. 1898; 447–482. 15 N. 1898; 519–538. 15 D. 1898.

Shaw, W. R. The Fertilization of *Onoclea.* Ann. Bot. **12**: 261, *pl. 19.* S. 1898.

Spegazzini, C. Una planta nueva de la flora Uruguaya. Ann. Soc. Cien. Argentine 47: 8–13. 1899.

Arechavaletaia gen. nov.

Stevens, F. L. The Effect of Aqueous Solutions upon the Germination of Fungus Spores. Bot. Gaz. **26**: 337–406. D. 1898.

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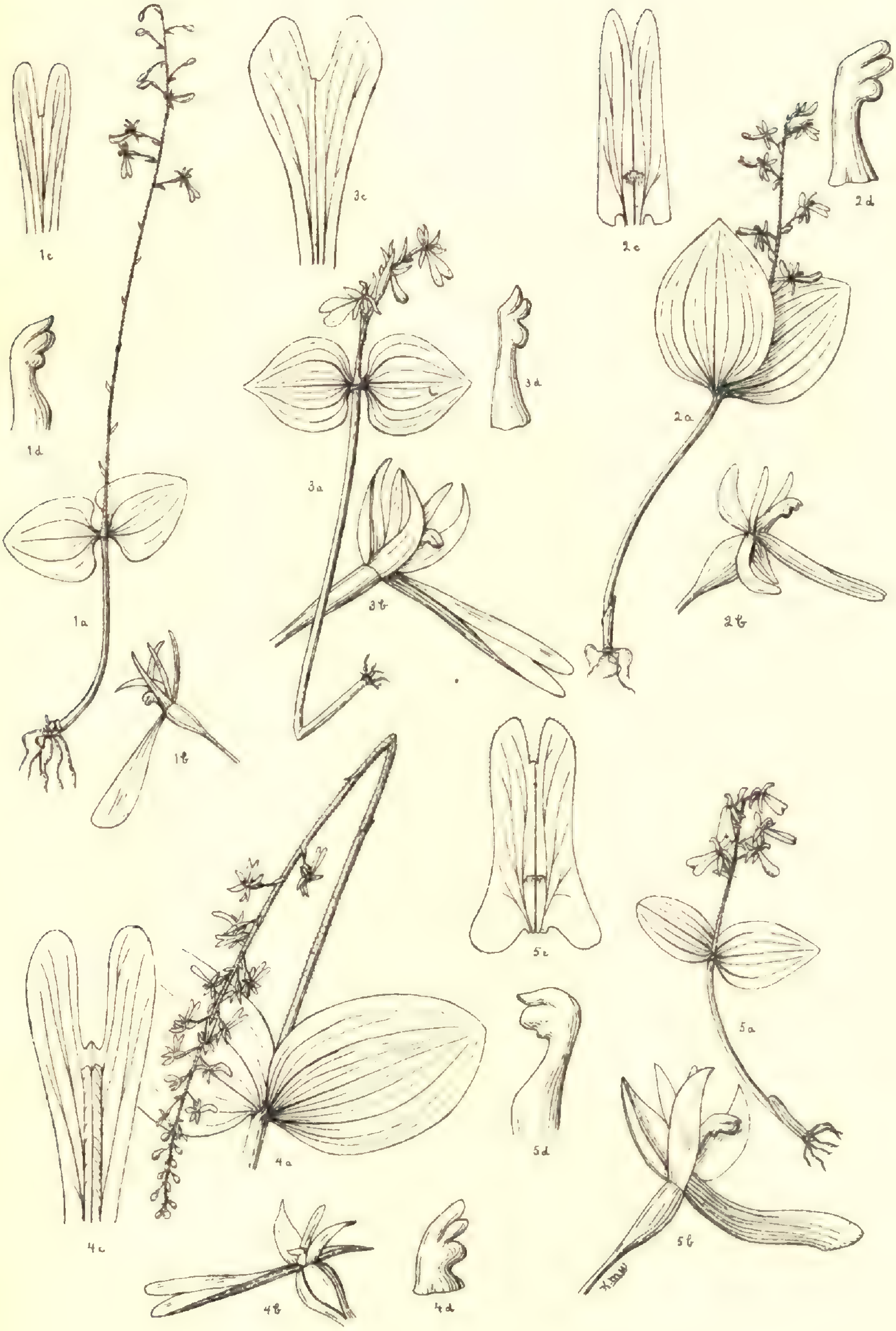
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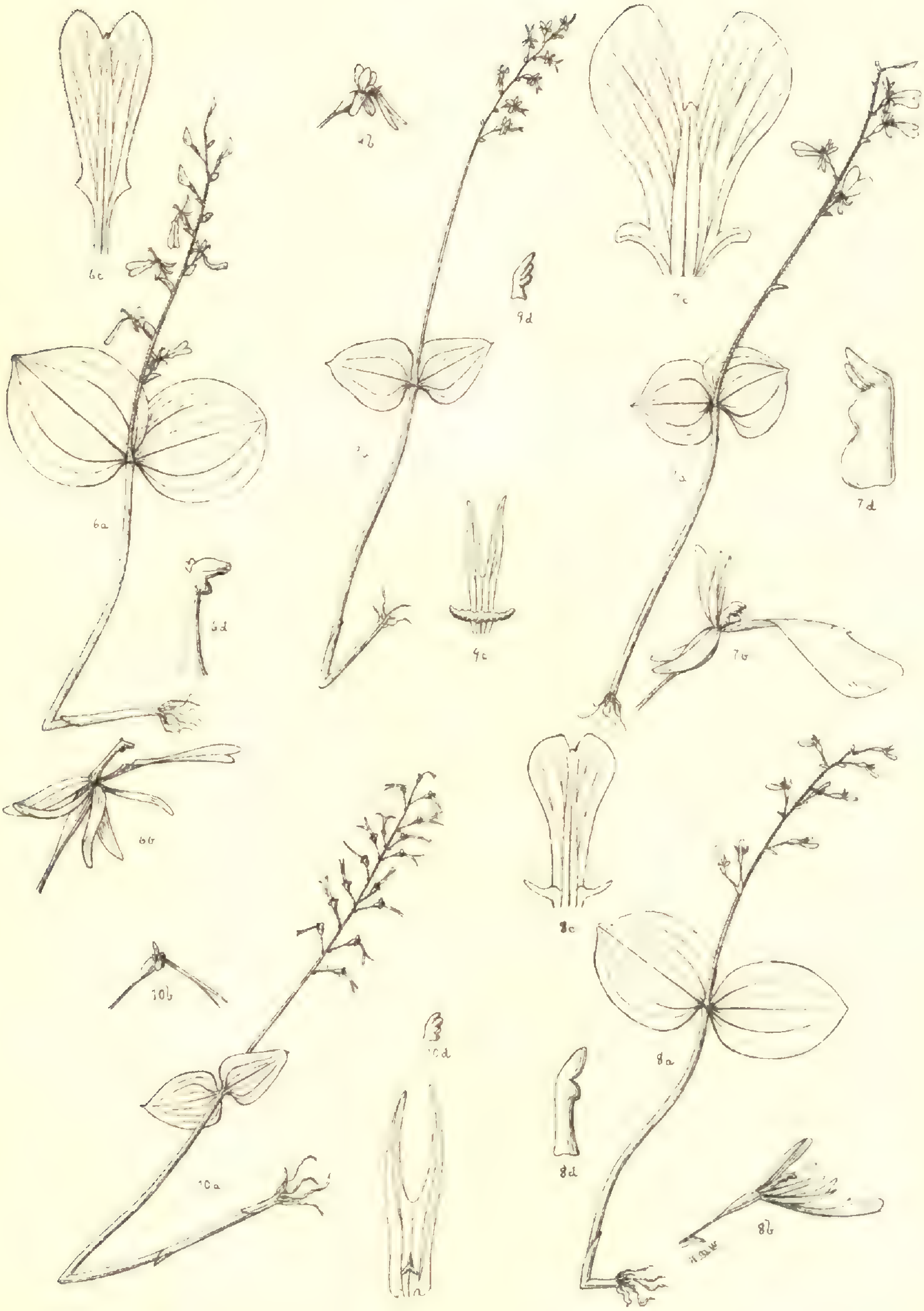
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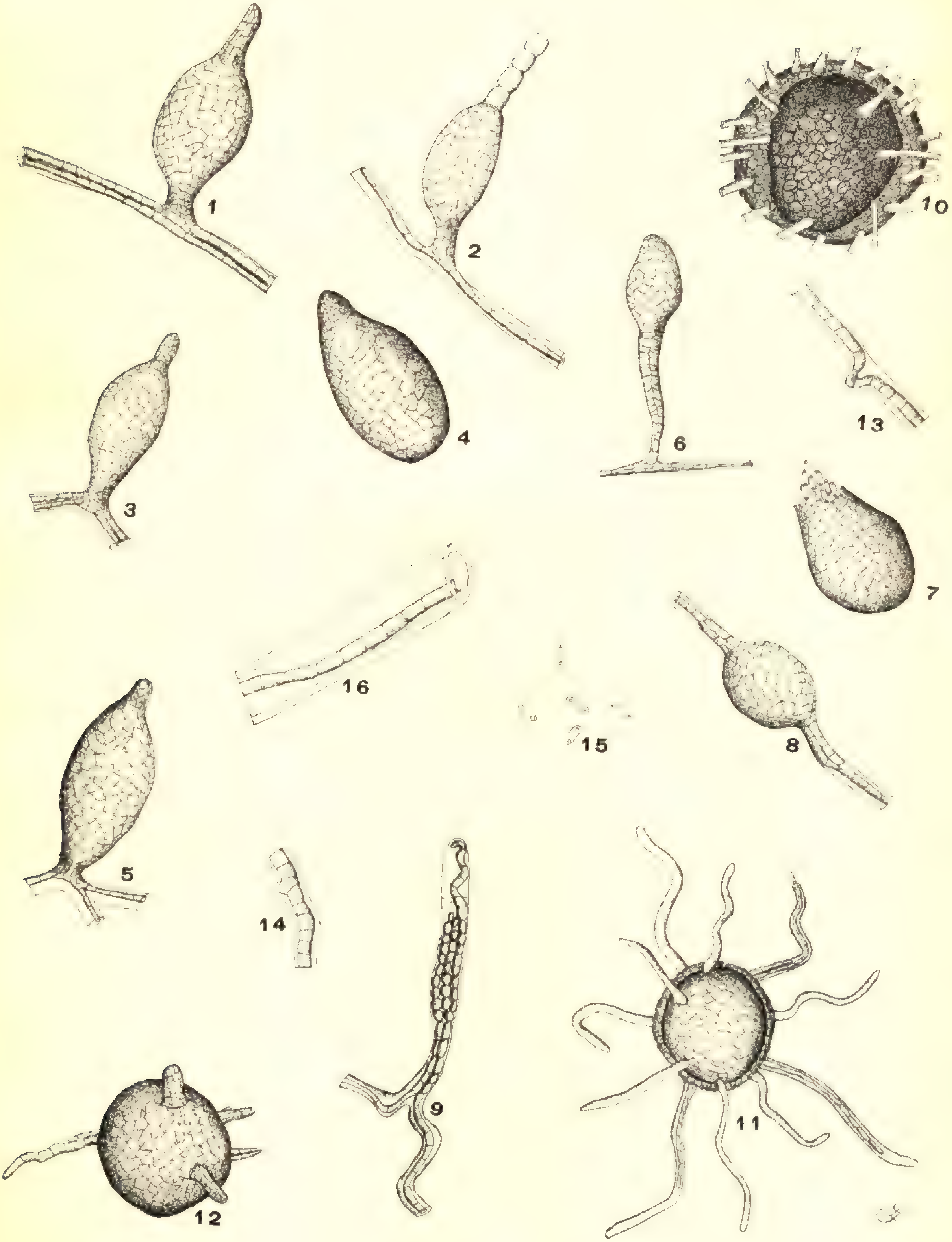
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MEMBERS OF THE CLUB will please remit their annual dues for 1899, now payable to Mr. Maturin L. Delafield, Jr., Treasurer, 56 Liberty St., New York City.

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BULLETIN
OF THE
TORREY BOTANICAL CLUB

MAY 1899

American Ferns—II. The Genus Phanerophlebia

By Lucien Marcus Underwood

(Plates 359, 360)

During the past generation it has been customary for English and American botanists to refer to a single species, *Aspidium juglandifolium*, a long series of widely different ferns from Mexico, Central America and Venezuela. The original *Polypodium juglandifolium* was described from Caripe, Venezuela, by Humboldt, and his type is in the Willdenow herbarium. The relation of our own flora to this species commenced with the discovery of a plant on the Mexican Boundary Survey * which was referred to this species although it specifically resembles the type almost as little as it does *Polystichum acrostichoides* or any one of a half dozen species.

Several species have been separated from time to time by Schlectendal, by Martens and Galeotti, and later by Fournier. The latter in his list of the Ferns of Mexico † distinguishes five species but his knowledge of the typical form appears to have been somewhat at fault. Later still, Mr. Hemsley ‡ following Mr. Baker, unites all these divergent plants under a single species and the forty-three specimens at Kew are included under a single cover.

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* Under the head of *Aspidium juglandifolium* in Eaton's Ferns of North America, we have the curious anomaly of a description of one species, a figure drawn from a second, details of venation from a third, and the name of a fourth given to the aggregation.

† Mexicanas Plantas, 1 : 100. 1872.

‡ Biologia Centrali-Americana, 3 : 642. 1885.

[Issued 15 May, 1899.]

The genus *Phanerophlebia* (Presl, Tent. Pteridogr. 84. 1836) was established by Presl together with the genus *Amblia* (Presl, Tent. Pteridogr. 184. 1836) the former founded on *P. nobilis** and the latter on *P. juglandifolia*, the genera differing only in the supposed absence of indusia in the latter genus. It represents a somewhat natural group of plants of the Aspidieae with once pinnate leaves, coriaceous or herbaceous habit and 3–4-forked veins which in some species unite more or less copiously in the outer portions of the pinnae and in others remain free. In the species with normally free veins, however, accidental areolae sometimes appear. John Smith (in his later writings) and Moore united this genus with *Cyrtomium* whose type is the common *C. falcatum* of cultivation, but in that species and its allies a widely different type of venation occurs which in our judgment is sufficient for generic distinction. The relations of this genus to other generic groups which have been united under *Aspidium*, *Nephrodium*, and other names will be discussed later in this series of papers.

The genus *Phanerophlebia* has a limited distribution, ranging from the northern coast of South America to Arizona and New Mexico. There are at least eight species which may be easily separated as follows:

- Veins regularly and copiously anastomosing.
  - Pinnae 5–11, 4–5 cm. wide; inner line of sori near the midrib. 1. *P. juglandifolia.*
  - Pinnae 16–20, 2–3 cm. or less wide; inner line of sori 3–5 mm. from the midrib. 3. *P. remotispora.*
- Veins free or exceptionally anastomosing at rare intervals.
  - Pinnae 3–5, cordate at base. 2. *P. pumila.*
  - Pinnae 10–30, acute or obliquely obtuse at base.
    - Pinnae 7–15 cm. long, normally set at an angle of 50–75° with rachis.
      - Pinnae mostly auricled on the upper side of the base. 6. *P. auriculata.*
      - Pinnae obtuse or acute at base, not auricled.
        - Inner line of sori near the midrib; rachises smooth. 4. *P. nobilis.*
        - Inner line of sori 4 mm. from midrib; rachises scaly. 5. *P. umbonata.*

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* While this genus is nominally founded on *P. nobilis*, the description and figure of the venation show a plant with anastomosing veins and it is more than probable that *P. remotispora*, a species not separated until over thirty years later, was the plant Presl had in hand. This point, which does not affect the establishment and validity of the genus, can probably be settled by an examination of Presl's plant at Prag.

Pinnae 18–20 cm. or more long; normally set at an angle of 30–40° with the rachis.

Sori in a single row with two others incomplete, 2.5 mm. in diameter.
7. *P. macrosora.*

Sori usually in four or less complete rows, small, 1.2 mm. wide.
8. *P. Guatemalensis.*

1. PHANEROPHLEBIA JUGLANDIFOLIA (H. & B.) J. Sm. Hook. Jour. Bot. **4**: 187. 1842.

Polypodium juglandifolium Humb. & Bonp.; Willd. Sp. Pl. **5**: 195. 1810.

Aspidium juglandifolium Kunze, Linnaea **20**: 363. 1847.

Cyrtomium juglandifolium Moore, Index Filicum, lxxxiii. 1857.

Amblya juglandifolia Presl. Tent. Pterid. 185. *pl. 7. f. 3.* 1836.

Rootstock short, ascending, with few scales: stipes slender, rarely with a few straggling scales, stramineous, 30–40 cm. long: pinnae 5–11 (mostly 7–9), 3–5 cm. apart, often with a tuft of tomentose scales in the axils, the terminal largest, 20 × 5 cm., the lowest smallest, 12 × 4.5 cm., often falcate; base obtuse; apex acute and often strongly acuminate; margin undulate below, becoming more and more distinctly serrulate toward the apex; texture subcoriaceous with a cartilaginous margin which extends into short rigid teeth, 0.5 mm. long; veins anastomosing throughout, the first row of areolae elongate, 1.5 cm., mostly with a free included veinlet which bears the first sorus about a millimeter from the base, the outer areolae smaller: sori 1.5 mm. across, the inner series 2 mm. from the midrib, the second series 5–7 mm. further out, a partial third series 2 mm. still farther removed from the midrib.

The type of this species is in Willdenow's collection at Berlin and is marked 434 Caripe,* Humboldt. This is almost exactly matched by a considerable number of specimens in various collections as follows:†

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* Caripe, not always shown on the maps, is near the north coast of Venezuela, 28 kilometers S. S. E. from Cumana.

† In the citation of specimens it is desirable to indicate in what collections specimens have been examined, both to convey information as to where specimens of any given species can be consulted and because of variations existing under the same number of certain collectors. In this paper the herbaria are designated as follows:—B, Berlin;—C, Columbia;—D, Davenport (Massachusetts Horticultural Society);—E, D. C. Eaton, New Haven;—G, Gray, Cambridge;—K, Kew;—N, United States National Museum, Washington;—P, Philadelphia Academy of Sciences;—U, the writer's own collection.

VENEZUELA: Humboldt, 434 (B); Miguel, 20 (K); Buschel, (K, E); Funcke, 211 (K); Otto, 644 (K); Linden, 164 (K); Fendler, 233, in part (E, P).

[COLUMBIA: Andes Bogotenses, Triana.]

GUATEMALA: Salvin & Godman, 113 (G, K); J. Donnell Smith, 1051 (K); 768 (K, G, C, P).

MEXICO—*Chiapas:* Ghiesbreght, 414 (K, G, E).

The typical form of this species from Venezuela is well named *juglandifolium*, as the resemblance to walnut leaves is very striking. The Guatemalan specimens of Salvin and Godman are provided with slightly larger pinnae (terminal 20 × 6 cm., lower lateral 20 × 5 cm. scarcely falcate) and with more pronounced bristle teeth; the Mexican specimens have smaller pinnae, 12 × 2.5–3 cm., and also more pronounced bristle teeth. All agree in the basal and apical characters of the pinnae, venation, position of sori, the number of pinnae and the general habit.

Much is still to be desired regarding the rootstock. The Venezuelan specimens collected by Fendler and distributed under no. 233 are quite different from each other. That of Eaton's collection and the one in Short's herbarium at the Philadelphia Academy are nearly normal, but those of the Kew and Gray herbaria are younger, show more scaly rootstock, longer stipes with quite large dark-brown scales, and with a larger number of sori, the outer rows being more irregular, particularly in the specimen in Herb. Gray. A second species is clearly involved under this number.

The species is, however, very sharply circumscribed, its geographical limits are clearly marked, and it is not to be confused with the very distinct species found farther north.

2. PHANEROPHLEBIA PUMILA (Mart. & Galeotti) Fée, Gen. Filicum, 282. 1852.

Aspidium pumilum Martens & Galeotti, Mém. sur les Fougères du Mexique, 64. *pl. 17. f. 1.* 1844.

Aspidium juglandifolium D. C. Eaton, Ferns of North America, **2**: *pl. 75. f. 5–8.*

Rootstock so far as known short and compact: stipes clustered, 5–11 cm. long, stramineous or brownish, densely scaly with narrow slender lanceolate scales: pinnae 1–5 (in one rare case 10), the terminal much the largest, 6–10 cm. long, 2.5–2.8 cm. wide, the lateral 3–3.5 cm. long, 2–2.5 wide, all cordate at the base, the terminal normally acute, the lateral mostly obtuse except for the terminal spine; margins with projecting spines 1 mm. long: sori in two usually complete rows with occasionally scattering outliers, the inner row 1–3 mm. from midrib, the second row 2–3 mm. farther out: veins free, 2–4 times forked, the sori borne mostly on the middle of the alternating branches.

MEXICO [*Oaxaca:* Galeotti, 6251]. *Chiapas:* Ghiesbreght (K, G, E, U); Linden, 1552 (K).

There appears to be considerable variation in the number of pinnae though the predominating number is 3 as seen by the following series examined:

Ghiesbreght (Hb. Eaton) 1, 2, 3, 3, 3, 3, 3, 3, 4; (Hb. Gray) 3, 5, 5, 10 *; (Hb. Underwood) 2, 4; (Nat. Herb.) 5; (Hb. Kew) 3, 3, 3, 5, 5, 5, 5; Linden (Hb. Kew) 3, 3, 3, 3.

The relation of this species to *P. Lindeni* is not clear. Of the latter I have seen only the Kew specimen (Chiapas, Linden, 1551) which is represented by two leaves with the following measurements: terminal pinnae 14 × 3 cm., lateral 9 × 2.3 cm., the terminal remote (2.5–3 cm.) from the lateral, all the pinnae taper-pointed.† In one of the leaves there is an auriculate base on each lateral pinna. In Eaton's specimen of *P. pumila* there is a single leaf strikingly similar to Linden, 1551, but smaller and totally unlike any of the other specimens of the sheet. This leaf is disconnected from the other specimens, so may belong to a different plant from the rooted specimen; its dimensions are: stipe 17 cm., terminal 10 × 2.3 cm., lateral 6.5 × 1.7 cm. While there is no question that we have in *P. pumila* a species totally distinct from any other of the group, only field work will determine whether we do not also have two. In other words *P. Lindeni* may be a distinct species.

3. PHANEROPHLEBIA REMOTISPORA Fourn. Mex. Plantas **1**: 100. 1872.

Rootstock unknown: stipes 35–40 cm. long, stramineous, with broad brownish scales on the lower fourth, naked above: leaf 35–40 cm. long, with 16–20 pinnae which are 10 cm. or more long, 1.5–2.8 cm. wide, unequally obtuse or slightly acute at base, the apex tapering, slightly falcate; margin prickly, the spines more or less appressed near the base, more spreading at the apex; terminal pinnae slightly larger: veins anastomosing, the first branch from each vein bearing a sorus above its middle, either ending as a free included veinlet or rarely uniting with some other vein: sori small, 1 mm. or less in diameter, in two or three rows, the innermost row 3–5 mm. from the midrib.

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* This leaf, which is separate from the other three which constitute the specimen, is also peculiar in showing broadly obtuse almost truncate bases to the lateral pinnae and an acute apex and with a falcate upper curve.

† It should be noticed that the pinnæ of Linden's 1552 are more acute than in hiesbreght's specimens.

The type of this plant was collected in Orizaba by Bourgeau, 2349, and appears to extend from southeastern Mexico to Guatemala.

MEXICO—*Vera Cruz:* Orizaba, Bourgeau, 2349 (K, N, G, C, E), 2348 (C); Mohr, 87 (E); Müller, 729 (C); Witmer, 99 (P). Xalapa, Coulter, 1712 (K). Cordoba, Schaffner, 23 (K); Kerber, 69 (K). Mirador, Liebmann (K, G).

GUATEMALA: J. D. Smith, 3259 (K, N, C).

The Guatemala specimens have narrower pinnae and fewer of slightly larger sori. Specimens are also in the Kew Herbarium from Mexico collected by Graham, 404, and from Zhuitlancella, 2349. In the Gray collection is a single plant collected in Xalapa by Charles L. Smith, mounted on two sheets, that has a lamina 75 cm. in length and with a stout stipe 65 cm. long. Except for its greatly enlarged size, its relations are with this species. At least without more data we would not care to separate it. It has 36 pinnae, the lowest 18 × 3 cm. with four or more rows of small sori on either side. It is more than probable that Fée's illustration of *P. juglandifolia* Gen. Fil., *pl. 22 B. f. 1.* is taken from this species rather than the one he attempts to illustrate.

4. PHANEROPHLEBIA NOBILIS (Schlecht.) Fée, Gen. Fil. 282. *pl. 22 B. f. 2.* 1852.

Aspidium nobile Schlecht. Linnaea, **5**: 610. 1830.

Rootstock stout, creeping, the bases of the stipes with large shining brown scales: stipes 22–30 cm. long, pale brown: leaves 40 cm. or more long, with 15–23 pinnae which are 12–15 cm. long, 2.3–2.8 cm. wide, with obliquely obtuse bases and tapering curved apices; margins spiny, the spines more pronounced in the upper half of the pinna: veins free, about three times forked, the first branch bearing the sorus below the middle: sori small or medium-sized, in about three rows, the innermost row less than 2 mm. from the midrib.

Apparently confined to central Southern Mexico. Specimens have been seen as follows:

MEXICO: San Nicolas, Bourgeau, 1049 (K, N, G, C, E*). *San Luis Potosi:* Schaffner (K, U). *Mexico:* Circa urbem Mexici, Schmitz, 26 (K). *Vera Cruz:* Oaxaca, Galeotti, 6554 (K); [Laguna de la Haciendo, Schiede]. Cañada, Bilemek, 474 (G, K); Orizaba? Müller, 48 (E); Cordoba, Bourgeau, 1645 (N).

This species can be easily distinguished from *P. remotispora*, which it closely resembles in size and habit, by its free veins and its inner row of sori located near the midrib. The original was collected by Schiede and Deppe as noted above.

5. **Phanerophlebia umbonata** sp. nov.

Rootstock stout, solid: stipes 15–30 cm. long, pale brown with a few broader scattered scales in the lower portion, and a considerable number of narrow slender ones above which also appear throughout the rachis: leaves 35–50 cm. long, with 25–38 pinnae which are 9–16 cm. long, 2–2.5 cm. wide, with an acute or obtusish base and tapering apex; margins bristly, the bristles scarcely projecting; veins free, very closely placed, usually three times forked, all the branches except the first extending to the margin: sori in about two rows, with a few scattering outliers, the innermost row about 4 mm. from the midrib; indusia remaining flat, with a central depression, and the center elevated into a distinct umbo.

Cool shaded cañons near Monterey, State of Nueva Leon, Mexico. C. G. Pringle, 14 June, 1888.

This plant was at first considered by Mr. Davenport as distinct from *juglandifolium* as indicated in our correspondence. The plant was issued in Mr. Pringle's sets without a specific name, but Mr. Davenport finally yielded his early impression and reported it under that convenient catch-all of the genus which *juglandifolium* has become through its treatment at Kew. American botanists of the past generation have regarded this treatment as authoritative, in spite of the vigorous protests of Moore, John Smith, Fée, Fournier, Mettenius and Kunze, variously expressed in the literature of the past forty years.

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* Two pinnae "ex herb Gray."

There is nothing in the extensive collection at Kew, which numbers 43 specimens in this group, to match this species. Its relations are closest to *P. nobilis* and *P. remotispora*; from the former it differs among other points in its remote sori; from the latter in its free veins; from both in its larger number of pinnae, its scaly rachis and its very characteristic indusium.

We have seen specimens of the distribution in the Kew, Gray, Columbia, National, Eaton, Davenport and Philadelphia Academy herbaria, besides our own specimens, and they show very little tendency to vary.

6. **Phanerophlebia auriculata** sp. nov.

Rootstock short, creeping, densely covered with the bases of the persistent stipes. pale greenish, stramineous, 10–18 cm. long, with abundant dark brown lanceolate scales which become narrower above and almost hair-like: pinnae 10–16, rarely exceeding this number, forming a leaf 15–30 cm. long, the terminal practically the same size as the others, 5–7 cm. long, 2–2.5 cm. wide; lateral pinnae unequal at base, the lower angle obliquely truncate, the upper usually developed into a well-marked auricle; margins strongly serrate, sometimes more deeply incised, the teeth ending in sharp prickles projecting from the margin at an angle of 30°–40°; texture thin; veins free, 1–3-forked: sori in 2 more or less clearly marked rows with scattering sori between them and beyond the outer row.

This is the plant that has too long masqueraded as the representative of *Aspidium juglandifolium* from the Southwest, but has no close resemblance to that species, in habit, foliage, venation or texture. Although not the first collected, we shall assume Pringle, no. 831, from "cool damp cliffs, Mapula Mountains, Chihuahua, October, 1886," as the type of the species since it is more widely represented in collections and more representative. The first collected plants of this species we have seen are in Kew labeled simply Mexico, Dr. Coulter, 1713, and though possessing a greater number of pinnae (20) than the type are clearly this species. The first collection within the limits of the United States was made in Western Texas on the Mexican Boundary Survey near "Hueco Tanks and Van Horn's Wells." The only specimen from this collection is in the Columbia Herbarium and is marked *Aspidium juglandifolium* Kze., D. C. Eaton, January, 1880."

It was next collected by Mr. and Mrs. Lemmon, August 12, 1882, in "Conservatory Cañon," Huachuca Mountains, Arizona, and ten years later by Professor E. O. Wooton in the Organ Mountains, New Mexico. The range of the plant is quite circumscribed as it appears to be confined to northern Mexico and the adjacent portions of the United States. The following may be referred here.

MEXICO—*Chihuahua:* Pringle, 831 (K, G, N, C, P, U) Palmer, 450 (K, E, N, P); Hartman, 578 (K, G) (plants mostly immature).

ARIZONA: Lemmon, August, 1882 (K, E, G, U, N).

NEW MEXICO: Wooton, May, 1892 (U).

TEXAS: Mexican Boundary Survey (C).

7. **Phanerophlebia macrosora** (Baker)

Aspidium juglandifolium, var. *macrosorum* Baker, Jour. of Bot. **25**: 25. 1887.

Rootstock unknown: stipes brownish, the color extending throughout the rachis: pinnae coriaceous, brownish in drying, 2.5–3 cm. apart, 18–20 cm. long, 2.5 cm. wide, the apex tapering, the base unequally cuneate with a distinct cartilaginous margin and brownish spines throughout: veins free, 3 times forked, the primary branch rising from near the base, short, bearing the sorus near its middle: sori very large, hemispheric, 2.5 mm. in diameter, forming a continuous inner row 2 mm. from the midvein and one or two more or less irregular outer rows leaving a considerable bare space near the margin.

COSTA RICA: J. J. Cooper (K, G).

This very distinct plant was distinguished by Mr. Baker as a variety but we can discover no close relation to *juglandifolium** to which he united it. It does not appear to be closely related to any of the described species of the group, but does show a striking affinity with the next species with which it forms a somewhat natural group. It is known only from its type locality unless the imperfect specimen at Kew collected by Skinner in Guatemala should belong here. There are no specimens in the U. S. National Herbarium, although the original material was sent thence to Mr. Baker.

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* Mr. Baker's brief description is as follows: "veins all free, conspicuously raised; sori much longer [*sic*] than in the type"

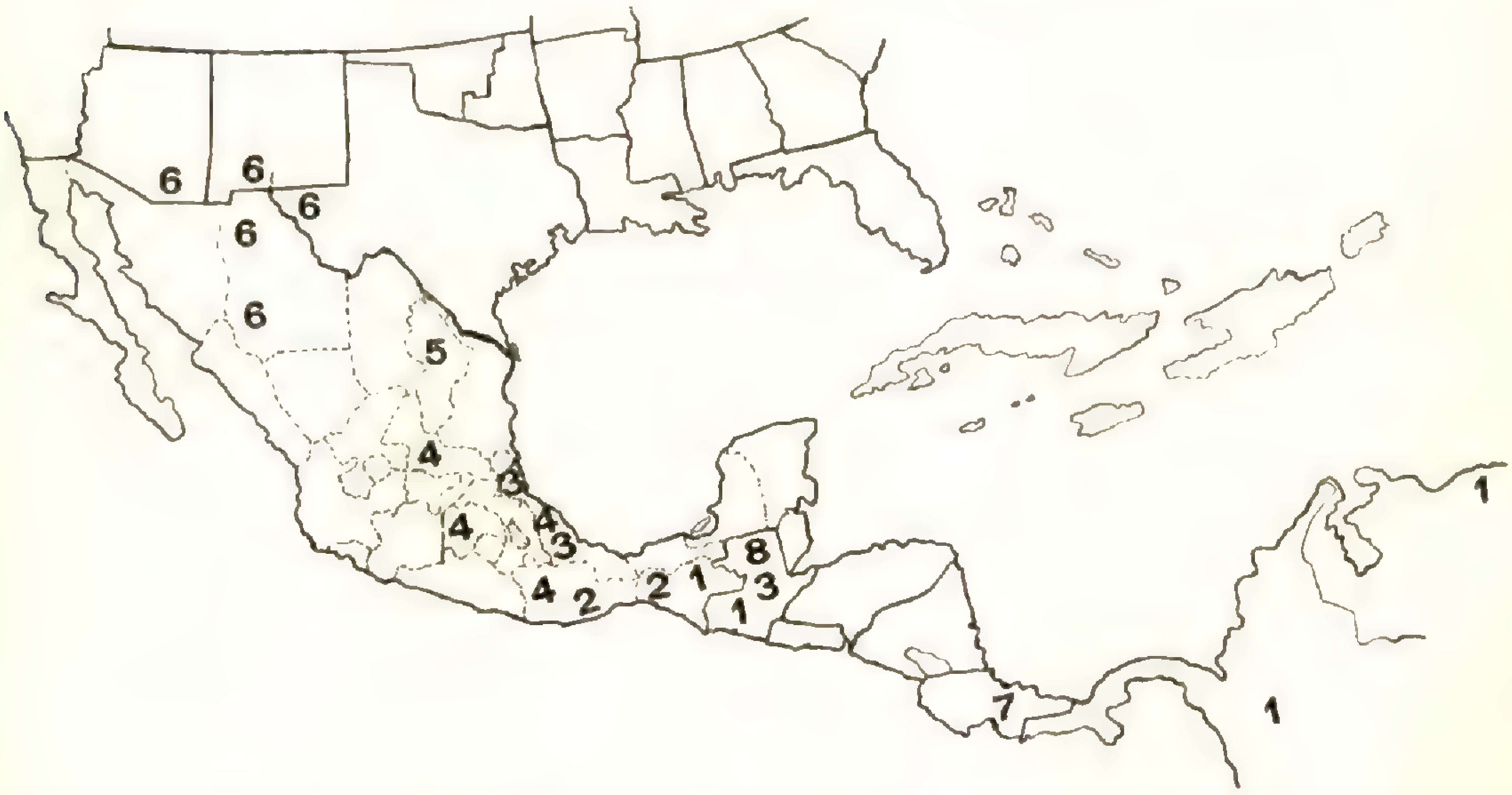
8. **Phanerophlebia Guatemalensis** sp. nov.

Rootstock unknown: stipes pale brownish, smooth: pinnae 20 × 3.5 cm., tapering at the apex, acute at base, with spinulose margins; veins free, prominent beneath in drying, four or more often five-forked: sori small, 1.2 mm. wide, mostly flattish in usually four rows either side the midvein, about equally distributed over the entire width of the pinnae: indusium small, withering.

Guatemala: San Miguel Uspantán, Depart. Quiché, alt. 7000. J. Donnell Smith, 3241 (G, N, P).

The specimen under this number in the Columbia Herbarium may be this species but more likely is something else. The plant is younger, the pinnae are smaller, the rachis is scaly, and its habit is quite different. There is a second Guatemalan plant in the Gray herbarium, collected by O. Salvin, that belongs here, as does another of the same collection at Kew. A tip of another specimen at Kew collected by Skinner is probably the same, although the pinnae are larger (27 × 4 cm.). The species finds its nearest alliance with *P. macrosora* but is abundantly distinct.

The geographic distribution of the known species may be compared more readily from the following map, in which the numbers of the stations correspond to the serial numbers of the species.



Distribution of the species of *Phanerophebia*: 1. *P. juglandifolia*, 2. *P. pumila*, 3. *P. remotispora*, 4. *P. nobilis*, 5. *P. umbonata*, 6. *P. auriculata*, 7. *P. macrosora*, 8. *P. Guatemalensis*.

Incertae sedis

1. *P. Lindeni* Fournier, Mex. Plantas **1**: 100. *pl. 4.* 1872.

As stated above there is considerable uncertainty regarding the relations of this species to *P. pumila.* Further collections will be necessary either to establish the validity of this species or reduce it to synonymy. Represented at Kew by Linden, 1551, collected in Chiapas.

2. In the Kew Herbarium is a specimen marked "Popocatepec., Mexique" Schaffner, no. 277, which is represented by a single leaf nearly a meter long, of which 45 cm. is stipe. The stipe is blackish at base, brownish, and then stramineous with occasional scales: pinnae 21, approximate in pairs, strongly bristly throughout, with a series of scattered scales everywhere on the veins beneath; the veins are free and the sori are in three rows very much as in *P. nobilis* which the plant resembles in many ways. Further material is here necessary to determine its position.

3. The specimens in the Kew and Gray herbariums collected by Fendler in Venezuela and distributed under no. 233 are not *P. juglandifolia* but present material is insufficent to determine its relations. It will thus be seen that while much is known of the genus, much yet remains to learn regarding complete distribution of the species.

The data presented by the above study illustrate several principles of wide application in the study of our flora, and particularly that portion of it which connects directly with the flora of Mexico and the West Indies, where, of necessity, the early types are found in the herbaria of the old world.

1. The necessity for the American flora to be monographed by Americans in whom some conception of distribution is apparent from the better perspective inherent in natives of a large country.

2. The coördinate necessity for American monographers to consult the large European collections before completing their studies of relationship and distribution. An earlier examination of Willdenow's type in this instance would have prevented much of the difficulty which has resulted from the misinterpretations of both Europeans and Americans. Few European botanists have taken the trouble to consult types on their own continent outside of the herbaria in which they work; consequently, for the study of the American flora, Americans must do this and do it systematically.

3. The uncertainty of referring to collectors' numbers unless the special herbaria in which the plant is consulted is also added. While the numbers of certain collectors are almost always homogeneous and represent a single species, those of certain other collectors are notorious for the want of uniformity of the specimens, since the commercial rather than the scientific conception has governed their distribution.

4. The crying necessity for field workers to give more attention to the subterranean portions of plants and their habits of growth. In all of the large collections of the species described above that have been examined in the best herbaria, we are still in practical ignorance of the rootstock and growth characters of nearly all the species. To understand biological characters and relationships we must know more than the average specimens of a *hortus siccus* can reveal.

Explanation of Plates

PLATE 359

1. Lower pinna of *P. juglandifolia*; the outline drawn direct from Humboldt's plant in the Willdenow herbarium.

2. *P. pumila* from Chiapas, Ghiesbreght.

3, 4. *P. auriculata* from Chihuahua, Pringle, showing different development of the basal auricle.

5. *P. umbonata*, Monterey, Pringle.

All the figures are natural size.

PLATE 360

1. *P. juglandifolia* from Humboldt's plant in the Willdenow herbarium.

2. *P. auriculata.*

3. *P. remotispora.*

4. *P. umbonata.*

5. *P. nobilis.*

6. *P. nobilis*, from the same leaf as No. 5 but slightly more magnified.

The figures were drawn from the leaves by direct tracings with a Leitz projection apparatus, and are magnified about 2½ diameters.

Both plates were drawn under my direction by Miss M E. Baker.

COLUMBIA UNIVERSITY, 4 April, 1899.

Studies in Sisyrinchium—I: Sixteen new Species from the Southern States

By Eugene P. Bicknell

Only a few years ago our familiar Blue-eyed Grass was looked upon as a plant common to nearly all parts of North America and as being the only one of its genus occurring in all that wide extent of country except in the farthest west.

The species—actually the extensive *group* of species—has thus been altogether misunderstood.

Nearly ten years ago Dr. Watson, after a critical study of eastern plants, announced that two forms might fairly be regarded as distinct; but this view was not generally understood, and Dr. Morong, who examined the problem in the interest of the A. A. A. S. "List," published in 1893–4, reached the conclusion that but one eastern species should be accepted.

A familiar acquaintance with the forms occurring about New York City enabled me, two years later, confidently to define three eastern species and to intimate that yet others awaited critical discrimination. It was then my hope that the subject would be taken up by some one having wider opportunity for study, but as no new word on blue-eyed grasses had been said up to the present year, while the need of a better understanding of them had been pressingly brought to my attention, the study of our species was resumed. It seems, however, that the group has not been so entirely neglected as had been believed. This appears from a recent signature of "Pittonia," wherein Professor Greene adds five species to the number known from North America. Three of these are well known to me as excellent species. Two of them come within the scope of the present paper, one a strongly characterized Floridan plant, well named *S. xerophyllum*, the other from Louisiana, *S. Langloisii*, which from the description is evidently quite different from anything that has come under my notice.

The present series of papers may be taken as preliminary to a general review of the genus in North America.

My acknowledgments to many friends and correspondents for the loan of indispensible material must be deferred to the final writing.

Sisyrinchium corymbosum

Tall and long-leaved, 30–62 cm. high, in scant tufts not fibrose at base, arising from distinct ascending rootstocks, the crowded roots becoming coarse and woody. Plant pale dull green and glaucescent, turning yellowish or brownish-green in drying, the spathes and bracts of the inflorescence sometimes purplish-tinged: leaves decidedly equitant at base in stout plants, stiffly erect and thickish, or becoming so, some of them usually surpassing the first node of the stem, closely striate, not rugulose, the edges smooth or nearly so or upwardly ciliolate towards the very acute apex: stem 2–4 mm. wide, flattened, the stem proper often much broader than the firm wing-margins, the sharp edges smooth or nearly so: inflorescence long-branched, fastigiate-subcorymbose, two or three times compound, the second series of branches and the peduncles in clusters of two or three or more, arising from short sheathing bracts; branches 7–14 cm. long to the slender peduncles which are about as long and more or less serrulate: lowest bracteal leaf foliaceous, erect, 4–8 cm. long, those above much reduced and bract-like, 1.5–3.5 cm. long, usually clasping for about half their length and oppositely bi-carinate at base: spathes erect or deflected, small and narrow, mostly 12–15 mm. long, the nearly equal bracts thin and membranous, delicately nerved, acute or subulate, the margins rather broadly white-hyaline, the outer one tubular-clasping for at least one third its length; interior scales much shorter than the bracts: flowers blue, small, numerous, 8–11, on exserted, slightly spreading pedicels, 10–15 mm. long, becoming 15–22 mm. long in fruit; perianth delicate, apparently only 8–10 mm. long; stamineal column 3–4 mm. high: capsules broadly oblong, 3–5 mm. high, thick-walled, becoming dark brown; seeds globose, 1 mm. in diameter, faintly pitted or nearly smooth.

Florida: "Pine barrens near Jacksonville," A. H. Curtiss, "no. 4584, Curtiss' Second Distribution of plants of the southern United States," March 17, 1894, just in flower; June 1, 1894, over-ripe fruit. In Herb. U. S. National Museum.

Alabama: Mobile, Dr. Chas. Mohr, "Damp grassy banks:" just in flower April 5, 1897. In Herb. Dr. Chas. Mohr. Apparently a reduced form of the type, more slender and less branched, with elongated bracteal leaf.

A fine species, when well developed much the largest of the genus in the eastern United States. It is well characterized by its branched, sub-corymbose, bracteate inflorescence and long stiffly erect leaves.

Sisyrinchium solstitiale

Known only in its early-flowering stage. Thinly tufted from erect woody rootstocks, the very slender roots long and wiry, the bases of the tufts clothed with chaffy and loosely fibrillose remains of decayed leaves. Stems and leaves pale dull green or glaucescent, turning dull brownish-green in drying: leaves very straight and erect, 15–25 cm. long, about half the height of the plant, very narrow when young, becoming 4 mm. wide, evenly graduated to the stiff acicular apex, striate, the nerves mostly prominent and obscure in an alternating series, the intervals minutely transversely rugulose; margins of the leaves for a width of about .5 mm. thinner and paler than the interior portion in evident contrast, at least in the dried plant, the extreme edge hyaline and minutely serrulate, becoming smooth; stems once or twice spirally twisted, forming an erect double curve, 20–46 cm. or more tall, becoming 3 mm. wide, the firm wings hyaline-margined and obscurely serrulate, becoming smooth: inflorescence elongated, narrow, from three rather remote nodes, each supporting an erect, foliaceous bracteal leaf and one or two peduncles, or the lower one bearing a slender branch having a bracteal leaf and two peduncles: spathes dull green, straight, 2–2.5 cm. long, the bracts stiff, closely striate-nerved, subequal, acute or aculeate, the outer one narrowly acuminate, its margins below white-hyaline, united around the inner for 6–8 mm., or over one third of its length; interior scales acuminate, finally equaling the bracts: flowers blue, rather strongly veined, apparently few, about 12 mm. long, on erect slightly exserted pedicels.

Collected by Mr. Geo. V. Nash in high pine land at Eustis, Lake Co., Florida, Aug. 10, 1894, the first flowers just opened. Type in herbarium Geo. V. Nash.

A very distinct species remarkable for its late flowering period. *S. xerophyllum* Greene, which occurs at the same locality, flowers in March, five months earlier in the season.

Sisyrinchium xerophyllum Greene, Pittonia, **4**: 32. 17 M. 1899.

Tufts coarsely brown-fibrose at base from compound woody rootstocks, each separate stem arising from a short annular caudex: stem and leaves dull brownish-green, glaucescent, turning dark brown, stiff, closely striate, transversely rugulose or granulose between the nerves, the edges rough-serrulate or becoming nearly smooth: leaves stiff and erect, becoming flexuous in withering, attenuate-acute, 2–4 mm. wide, 25–45 cm. long: stems 15–35 cm. high, 2–3 mm. wide, prominently winged, above passing into an erect, often elongated, bracteal-leaf subtending a lateral-appearing cluster of 2–6 short-peduncled spathes and rarely also a branch bearing shorter peduncles; peduncles narrowly wing-margined, the edges obscurely roughened or becoming smooth, 2–6 cm. or even 10 cm. long, slightly curved, approximate and subequal, the outer two or three arising from a cluster of bracts borne on a very short prolongation of the stem. At flowering time the spathes are contiguous in a subsessile cluster: spathes erect or deflected, 14–19 mm. long, 3–4 mm. wide, dull green or slightly purplish, the bracts conspicuously hyaline-margined, subequal, stiff-herbaceous, striate-nerved, somewhat carinate, rather rigidly acuminate, the outer one sheathing for 2–4 mm. at base: interior scales crowded, at maturity exserted: flowers numerous, 8–12, rather large, violet; perianth delicate, becoming 12 mm. or more long; stamineal column 5–6 mm. high: capsules on pedicels 15–20 mm. long spreading or recurved from the tip of the spathe, 4–6 mm. high, trilobate-obovoid or subglobose, impressed at base and retuse, drying dark: seeds black, rugulose, becoming over 1 mm. in longer diameter.

The type is Nash's no. 133, "Plants of Central Peninsular Florida" collected in vicinity of Eustis, Lake County. This distribution furnished many excellent specimens in flower and early fruit collected, "March 20, 1894, in dry, sandy soil along road in high pine land region."

The Philadelphia Academy Herbarium has a specimen just in flower collected March 5, 1888, at Okahumpka, Sumpter County, by Isaac Burke.

The earliest collector of the plant would appear to have been Chapman, judging from an old sheet bearing his signature, now in the Herbarium of Columbia University, labeled "Florida, on Sand Hills, 1842."

On the strength of this specimen I drew attention to the plant three years ago in the paper previously referred to and published a brief description. The present description, which was ready for the press when the plant received its recent christening by Professor Greene, is given in full, being based on fairly extensive material, including flowers and fruit which Professor Greene had not seen.

Sisyrinchium tortum

Stiff and erect in thin tufts coarsely fibrous at base arising from a dense cluster of rather stout fibrous roots; 15–30 cm. high, not turning dark in drying; leaves firm, the larger ones equaling the stems or nearly so, finally close-striate and faintly vermiculate-rugulose between the nerves, like the stems mostly 1.5–3 mm. wide with the edges smooth or obscurely denticulate-roughened; stem wing-flattened, usually one to four times spirally twisted and sometimes forming a shallow sigmoid curve; node usually only one, bearing a short erect bracteal leaf subequal with the two peduncles or shorter; occasionally a lower node bears two longer and more slender erect peduncles; bracteal-leaf with a broad clasping base which is strongly striate and oppositely more or less bicarinate; terminal peduncles two, rarely three, short, 2–5 cm. long, parallel or divergent, usually slightly unequal; spathes usually abruptly broader and thicker than the peduncles, 10–16 mm. long, becoming 3 mm. wide; bracts subequal or either one the longer, rather thin and membranous, striate-nerved, the outer one obtuse, or sometimes acute, the margins broadly hyaline, sometimes to the apex, united-clasping for 1–3 mm. at base; inner bract often broadly obtuse and scarious at apex; interior scales narrow and attenuate, shorter than the bracts; flowers pale blue on slender, loosely erect, finally exserted pedicels 15–22 mm. long; perianth 8–10 mm. long, the rather broad segments very delicately nerved; stamineal column short, 2–4 mm. high. Capsule not seen.

Mississippi and Florida: Biloxi, Miss. Professor S. M. Tracy, March 15 and 20, 1898, just in flower. St. John's River, Florida, in Herb. Acad. Nat. Sci. Philadelphia, a single specimen on a sheet bearing also specimens of *S. xerophyllum* Greene, and *S. Floridanum*, the former collected by Isaac Burke in 1888.

Apparently nearest *S. xerophyllum* Greene, but unmistakably distinct.

Sisyrinchium Carolinianum

In loose tufts fibrose-coated at base, arising from erect or ascending rootstocks, the roots thickly clustered and rather coarsely fibrous, plant pale and glaucescent, often rather a bright yellowish green; leaves often much shorter than the stem, though sometimes reaching the first node, rather thin and openly erect, rather weakly striate-nerved, mostly 2–3 mm. wide or a few much broader, even 5 mm. wide, acuminate, the margins usually distinctly serrulate: stems erect, 2–3 mm. wide, broadly winged, the edges mostly serrulate or even ciliolate; nodes of stem one or two, each bearing a foliaceous bracteal leaf and two or three rather long more or less diverging peduncles; prolongation of stem beyond the first node commonly 5–7 cm. long and somewhat outcurved; peduncles 4–8 cm. long, often ciliolate-denticulate: spathes green or sometimes purplish, as a rule not at all deflected, 15–20 mm. long, the bracts sub-equal or either one slightly the longer, varying from herbaceous-attenuate to scarious-obtuse and mucronulate; interior scales about half the length of the bracts: flowers 3–8, on very delicate slightly exserted, loosely erect pedicels; perianth very delicate, pale violet-blue, 8–10 mm. long; stamineal column 4–5 mm. long: fruit not seen.

Western North Carolina and central South Carolina to Georgia, Alabama and Mississippi. Beginning to flower in the Carolinas in early May, at its southern limit a month earlier.

North Carolina: near Columbus, Polk Co., E. C. Townsend.

South Carolina: Andersonville, Anderson Co., Professor Lewis R. Gibbes, 1886. Type, in Herbarium N. Y. Botanical Garden; near Hamburg, Gibbes; Camden.

Georgia: Augusta, A. Cuthbert; Stone Mountain, Dr. Small.

Alabama: Auburn, F. S. Earle and C. F. Baker; Mobile, Dr. Chas. Mohr.

Mississippi: E. Hilgard.

Appearing somewhat intermediate between *S. graminoides* Bicknell and *S. Atlanticum* Bicknell, but perfectly distinct from both.

Dr. Mohr's specimens from Mobile and those from Mississippi are aberrant and may represent yet another species.

Sisyrinchium Floridanum

Tufts densely fibrillose at base, roots clustered, slender and wiry, stems and leaves 25–40 cm. high, pale dull green and glaucescent, not discoloring in drying, minutely crystalline-puncticulate; leaves numerous, equaling the stems or shorter, stiffly erect or ascending, becoming flexuous in withering, mostly 2–3 mm. wide, rarely 4 mm., closely and firmly striate, attenuate to the terete or sub-terete slender-pointed apex, the edges smooth; stems sub-terete with narrow but firm wing-margins, 2–3 mm. wide, the edges smooth, bearing near the top a slender, erect bracteal leaf, shorter than the 2–3 usually erect peduncles, sometimes erectly prolonged beyond the node and bearing a second cluster of three shorter peduncles; peduncles very slender, mostly less than .5 mm. wide, narrowly margined, smooth or sometimes obscurely denticulate, subequal, or usually so, 5–10 cm. long, transversely constricted below the spathe: spathes green or slightly purplish, mostly erect, narrow, 15–20 mm. long; bracts subequal, striate-nerved, hyaline margined, attenuate, mucronulate-acute or aculeolate, or the apex of the inner one apiculate from a narrowly scarious-obtuse or even bifid tip, the outer one clasping for 2–5 mm. at base; interior scales about equaling the bracts or slightly exserted; flowers 5–11, on slender exserted pedicels, pale blue, perianth delicate, about 10 mm. long: capsules pale green or purplish tinged, trigonous-subglobose or obovoid, abruptly contracted above and below, 3–4 mm. high, on pedicels 20–25 mm. long, exserted and slightly diverging for about quarter of their length: seeds not fully mature.

Based chiefly on Nash's no. 13, "Plants of Central Peninsular Florida"; collected "near Lake Dot, Eustis, on dry sandy hillside, March 12, 1894." In flower and fruit.

The same plant was collected by Prof. Underwood, also at Eustis, in 1891, and further specimens have been examined as follows: Hibernia, March, 1869, W. N. Canby; Pine Barrens near Jacksonville, March 17, 1894, A. H. Curtiss.

Sisyrinchium Nashii

Nearly related to *S. Floridanum*, but much smaller and slenderer, and flowering in June and July instead of March.

Very slender and delicate, growing in thin wisps of a few stems and leaves sheathed with a dense fibrillose coating around the base, leaves few, erect, about half the height of the stem, .5–2 mm. wide, rather less closely and strongly striate than in *S. Floridanum* and frequently denticulate, especially towards the scarcely terete apex: stems few, erect, 20–30 cm. high, mostly 1 mm. or less wide, the very narrow margins often, or usually, minutely denticulate; leaves, stems and peduncles sometimes obscurely roughened with minute points on the sides: bracteal leaf almost setaceously slender, much shorter than the peduncles; peduncles 1–3, almost filiform, often not perceptibly margined, more or less unequal, mostly 4–6 cm. long: spathes narrow, 13–15 mm. long, the bracts mostly thinner and less sharp-pointed than in *S. Floridanum*, the inner one frequently surpassing the outer and scarious-obtuse at the apex; flowers smaller than in *S. Floridanum*: capsules pale, 2–3 mm. high, subglobose or often broader than long on slenderly exserted subspreading pedicels 17–22 mm. long: seeds subglobose, black, finely rugulose-pitted, with a large umbilicus.

Based on Nash's no. 1395, "Plants of Central Peninsular Florida" collected near Lake Swatara, Eustis, in dry sandy soil of low pine land region, July 24, 1894, in flower and mature fruit; and Nash's no. 1914, collected at Eustis, June 11, 1895, in full flower and with very young fruit.

So near to *S. Floridanum* that I should scarcely have thought of looking for specific differences between the two plants but for the wide difference in their flowering periods as shown by the labels. Mr. Nash is satisfied that the plants are distinct and recalls that in the field he regarded the smaller plant of low pine land as certainly different from the similar species collected in the same region, but in high pine land four months earlier in the season.

Sisyrinchium rufipes

Early flowering stage: Thinly tufted from ascending rootstocks, the old leaves disintegrating to form a loose coating of bright rufous-red fibers about the base of the plant. Stem and leaves rather bright pale green and glaucescent partly turning a dull brownish green; leaves very slender, about the height of the stem, straight and erect but becoming widely flexuous in withering, 1–1.25 mm. wide, slenderly attenuate, more or less granular-scabrous between the close nerves, the margins finely sharp-serrulate; stems erect, about 1 mm. wide, narrowly margined, the edges closely appressed ciliolate-serrulate; bracteal leaf slender and erect, subtending two short suberect or outcurved peduncles and sometimes also a branch bearing a bracteal leaf and two short-peduncled spathes; branches and peduncles hirsutulous-ciliolate on the edges and often roughened with minute points on the sides: spathes short, about 12 mm. long, the bracts somewhat divergent, sharp-acuminate or the inner one scarious-obtuse and apiculate, the outer one hyaline margined below and slightly sheathing at the base: flowers 2–5, small, blue, on delicate slenderly exserted pedicels 15–17 cm. long; perianth about 8 mm. long; stamineal column 4 mm. high.

Georgia: Augusta, A. Cuthbert, "dry sand hills," March 24th. In herbarium J. K. Small.

Imperfect specimens from Summerville, South Carolina, collected by Professor Lewis R. Gibbes, April 9, 1850, just in flower, are probably to be referred here. They are more slender than the type with flexuous stems and leaves, and are nearly smooth throughout, but with the bracts minutely granular-scabrous.

In Herb. N. Y. Botanical Garden.

A specimen in Herb. U. S. Nat. Mus. no. 220, 346, wet pine barrens, Craven County, North Carolina, July 3d (G. McCarthy) doubtless also belongs here, but shows a mature plant of very different aspect. The stems are tall, and about twice spirally twisted, the tallest 47 cm. high and bearing at the node two slender peduncles and a longer divergent branch terminating in a cluster of three peduncles; the spathes are slenderer and longer than in the type, with narrow stiffly attenuate slightly unequal bracts. The capsules are brown and thick-walled, ovoid subglobose, and 3.5 mm. high; the immature seeds are rugulose-pitted and about 1.25 mm. in diameter. The stem and leaves, slightly broader than in the type, have dried very dark, but they show the same character of densely ciliolate-serrulate margins and also indications of granulose roughening on the sides; the fibrous tuft at the base of the plant is of much the same character as in the type but of a duller, more brownish color.

Sisyrinchium fuscatum

Growing in thin tufts, 15–50 cm. high, fibrose about the base, and arising from rather stout rootstocks and clustered widely spreading fibrous roots. Plant dull green and glaucescent, crystalline puncticulate, discoloring in drying, sometimes becoming almost black: leaves long and slender, but shorter than the stems, firm and erect, becoming flexuous, .5–2.5 mm. wide, acute or slenderly subterete at the apex, strongly close-striate, the edges smooth or denticulate-roughened: stems long and slender, erect, .75–2 mm. wide, at least the wings distinctly striate, the edges minutely denticulate, becoming smooth; bracteal leaf short, and erect, attenuate above, the broader basal portion strongly close-striate, surpassed by the two closely approximate and subequal, erect, slender peduncles, which are subterete and only 2–6 cm. long: spathes erect, narrow, but abruptly wider than the constricted peduncle, 15–18 mm. long, the bracts equal or nearly so, stiffly herbaceous and firmly close-striate, closely approximate, cuspidate-acuminate, the outer one clasping for 2–4 mm. at base; interior scales much shorter than the bracts: flowers 5–8, blue, on erect, more or less exserted pedicels, 18–25 mm. long; perianth about 10 mm. long, the segments narrow, rather closely and strongly nerved: capsules 2.5–4 mm. high, broadly subglobose, drying dark.

Western Florida to Mississippi.

Flowering from March to May.

Florida: Apalachicola, Chapman.

Alabama: Flomaton, Escambia county, April 23, 1898, C. F. Baker.

Mississippi: Biloxi, Prof. S. M. Tracy; Ocean Springs, Miss Skehan.

I find two sheets of this species in Herb. Missouri Botanical Garden, "ex coll. D. V. Dean," but without other record.

Sisyrinchium flagellum

Very slender and flexuous in thin tufts, not fibrose at the base, the roots becoming rather coarsely fibrous; pale dull green and slightly glaucescent, darker in drying, 20–32 cm. high. Leaves as long as the stems or nearly so, narrow and flexuous, 5–1.5 mm. wide, distinctly rather few-striate, smooth-edged or serrulate at the attenuate acute apex: stems erect, usually more or less flexuous, and geniculate at the nodes, .75–1.5 mm. wide, narrowly wing-margined, smooth-edged; nodes one or two, remote, the lowest about midway in the stem or higher, supporting a long leaf and one or two long slender peduncles, the upper node bearing a shorter leaf and two or three peduncles; peduncles very long and slender, 5–12 cm. long, mostly .5 mm. wide, smooth-margined, subequal, approximate or slightly divergent: spathes often abruptly deflected, narrow, 15–20 mm. long, the bracts slightly keeled to the apex, subequal or the inner one longer, the outer one narrowly acuminate and sharp-pointed, hyaline-margined below and clasping for 5–7 mm. at base; the inner one often scarious margined to the abruptly mucronulate apex; interior scales much shorter than the bracts: flowers not well made out, of some shade of blue and apparently of medium size: capsules 4–6 on erect slightly exserted pedicels 18–20 mm. long, trilobate-subglobose, retuse and impressed at base, about 4 mm. high, drying brown, the surface minutely rugulose: seeds globose, finely alveolate, 1 mm. or more in diameter.

South and West Florida: "Pine Key, Blodgett." In Herbarium of Columbia University.

Manatee County, Dr. J. T. Rothrock; "open glades," March 5, 1887; in flower and fruit. Specimens in herbarium of College of Pharmacy, New York and Philadelphia Acad. Nat. Sci.

Sisyrinchium Miamiense

About 20 cm. or more high, growing in small erect tufts from short descending rootstocks, the roots long, somewhat woody and nearly simple. Plant apparently dull green and glaucescent, drying dark: leaves erect, about three quarters the height of the plant, 1–1.5 mm. wide, cuspidate-acute, with somewhat thickened corneous tips, rather strongly but not very closely striate-nerved, serrulate: stems rather loosely erect, about the width of the leaves, distinctly wing-margined, denticulate-serrulate, bearing two or three erect peduncles at the top and sometimes an ascending branch lower down; peduncles approximate, 3–7 cm. long, their margins serrulate to smooth: spathes mostly erect, 13–15 mm. long, the bracts rather sharply keeled to the apex, the outer one stiffly acute, slightly hyaline-margined below and clasping for 1–4 mm. at base, slightly surpassing the inner, which is scarious-obtuse at the apex and apiculate; flowers 5–8, blue, apparently of medium size; capsules on exserted pedicels 15–18 mm. long, 3–5 mm. high, trigonous-obovoid or somewhat pyriform, mucronulate, thick-walled, brown, minutely rugulose: seeds irregularly subglobose- and bluntly angled, 1–1.25 mm. in diameter, faintly rugulose- pitted, obscurely umbilicate.

Southeast Florida; Miami, Dade County, Charles L. Pollard and G. N. Collins, April 4–7, 1898; Plants of subtropical Florida, no. 264; last flowers and mature fruit.

Sisyrinchium scoparium

Pale green and glaucous, growing in close tufts fibrose at base, from contracted rootstocks and rather coarsely fibrous roots, 15–50 cm. high. Leaves erect and very slender, equaling the shorter stems of the tufts but much shorter than the longer ones, 1 mm. or less to 1.75 mm. wide, very acute, the edges sometimes obscurely roughened; stems equally narrow with the leaves, very smooth, the striate wing-margins sometimes obscurely roughened above on the edges; inflorescence when well-developed appearing somewhat flabellately short-branched from two often approximate nodes of the stem, the lower node bearing one or two short, slender peduncles, the upper one two or three shorter peduncles; the peduncles and short branch all slightly diverging; bracteal leaves slender, rarely surpassing the spathes: peduncles 2–5 mm. long or the lower ones longer, denticulate on the margins; sometimes the stems bear but one node and two short peduncles; spathes erect, 12–18 mm. long, the bracts rather strongly close-striate, acuminate, subequal, the tips finally spreading; outer one narrowly hyaline-margined below, clasping for 2–5 mm.; interior scales about three quarters the length of the bracts; flowers 6–11, violet blue; perianth apparently with rather narrow segments, about 10 mm. long; capsules clustered on fascicled distinctly margined pedicels 14–20 mm. long, somewhat obovate or oblong-subglobose, 2–5 mm. high, thick-walled and drying dark, remaining slightly puberulent at maturity: seeds globose, black, finely pitted, 1 mm. in diameter.

Coast of Mississippi. Flowering from March to May.

Biloxi, April 27, 1898, C. F. Baker. Type in Herb. Alabama Biological Survey, no. 1496, also Biloxi, April 2, 1898, S. M. Tracy.

Sisyrinchium implicatum

Growing in close tufts from contracted rootstocks and producing a dense entangled mass of slender fibrillate roots; often assurgent at base, the numerous weak stems flexuous-erect or spreading in a loose entanglement, pale dull green, perhaps slightly glaucescent. Leaves very slender, weakly erect or flexuous, .5–1 mm. wide, 5–15 cm. long, narrowly blunt-pointed or acute, finely close-striate, the edges smooth, or serrulate when young: stems equally slender with the leaves narrow-margined, the edges smooth or obscurely denticulate, geniculate near the top at the single node and bearing 1 or 2 short peduncles with deflected spathes; peduncles almost capillaceous, margined slightly curved or straight, approximate, 2–4 cm. long, surpassing the slender bracteal leaf: spathes very small, the bracts somewhat membranous and finely nerved, equal, or either one slightly longer than the other; the outer one 10–15 mm. long, contracted-clasping for 3–5 mm. at base, narrowly acute, hyaline-margined below; inner bract acute or scarious-obtuse and apiculate: flowers 3–5, small, on pedicels slightly exserted or scarcely so; perianth very delicate and faintly nerved, pale blue, apparently about 8 mm. long; stamineal column about 5 mm. high.

Mississippi: Calhoun Co., "Wet bottoms," April 1858, E. Hilgard. In Herbarium Missouri Botanical Garden.

Sisyrinchium rosulatum

Prostrate or ascending in rosulate tufts, or sometimes nearly erect, pale dull green or glaucescent not turning dark in drying, the denser tufts from contractedly short-branched woody rootstocks, the roots delicate and fibrillate: tufts sometimes very small, becoming 25 cm. in diameter: basal leaves short, 2–8 cm. long, 1–2 mm. wide, the broadened base membranous and hyaline-margined, the weak nerves becoming rather distant, in larger leaves .5 mm. apart: apex of the leaf apiculate acute or sometimes more attenuate, the margins denticulate to closely sharp-serrulate or even sub-ciliolate: stems of the smaller tufts very short, only 6–30 mm. long, often concealed by the leaves, bearing one or two much longer peduncles: stouter plants may become 20 cm. high, the stems with two remote nodes each supporting an erect leaf and mostly two peduncles, or rarely the lower node developing a slender erect branch: stem slender, subterete, narrowly margined, the edges denticulate-serrulate: stem leaves much shorter than the peduncles, rather broadly flat-sheathing for 10–15 mm. above the node: peduncles long and slender, approximate or diverging, 2.5–10 cm. long, often more broadly margined than the stem, the edges aculeolate-denticulate: spathes relatively large, straight or deflected slightly transversely constricted at base, mostly about 2 cm. long, both bracts somewhat foliaceous, the outer one more attenuate and usually slightly the longer, rarely both bracts broadly foliaceous and prolonged, the inner one hyaline-margined nearly to the top, the outer one below the middle: flowers not seen, reported to me by Dr. Mohr as being of a reddish-purple or wine color: capsules 3–5, broadly subglobose, 2.5–3.5 mm. high on capillary flexuously spreading pedicels 2–3 cm. long, pale, but purplish-tinged along the sutures: seeds numerous, very small, .5–.75 mm. long, finely alveolate, umbilicate, assymetrically cuneate and angled.

Dry open places in sandy soil, coast of South Carolina and Alabama.

South Carolina: Sullivan's Island, May 8, 1852, Professor Lewis R. Gibbes. In fruit. In Herb. N. Y. Botanical Garden.

Alabama: Mobile, April 6, 1896, May 5, 1896, Dr. Charles Mohr. In fruit. In Herb. Dr. Mohr and Missouri Botanical Garden.

Very distinct from any of our eastern species, having its affinity with certain South American forms and a Mexican and Central American species which is perhaps unnamed.

Sisyrinchium furcatum

Loosely tufted, from rather stiff nearly simple fibrous roots, 10–15 cm. high; dull green, drying rather dark, mostly purplish about the nodes and bracts. Leaves about the height of the plant, erect, attenuate-acute, .5–1.5 mm. wide, rather thin, finely striate-nerved, the edges obscurely denticulate-roughened to smooth: stems 1–1.5 mm. wide, the wing-margins distinctly several-striate and denticulate, casually simple but commonly forking into 2 or sometimes 3 peduncles 3–6 cm. long, subtended by a slender, erect, bracteal leaf of about equal length: spathes relatively broad, about 3 mm. wide across the middle, the bracts delicately nerved and thin membranous on the sides, with broadly hyaline margins, mostly acuminate, the outer one usually prolonged beyond the inner 3–6 mm. and clasping for 2–3 mm. at base, the inner one often emerging rather abruptly; interior scales rather broad, brownish-tinged, much shorter than the bracts: flowers 4–6, blue; perianth very delicate and faintly nerved, 8–10 mm. long; stamineal column 4–5 mm. high: fruit not seen.

Southeastern Louisiana: Hammond, Tangipahoa Co., Lewena Gallup, April 4, 1889, "pine lands," in full flower. In U. S. Nat. Herb.

Sisyrinchium sagittiferum

Thinly tufted and slightly fibrillose at base, apparently not glaucous, drying dark, 10–15 cm. high. Leaves about equaling the stems .5–1.5 mm. wide, thin, striate-nerved, acuminate, the edges serrulate to smooth: stems very slender, .5–.75 mm. wide, margined to narrowly winged, the wings distinctly striate, mostly denticulate-roughened or above even papillose-aculeolate on the edges; spathes small, erect, terminating the stems and four or five times as broad, subequal or the outer one prolonged: outer bract 11–27 mm. long, acuminate or attenuate, sometimes surpassing the inner bract 15 mm., the white-hyaline margins only slightly united at base; inner bract 10–12 mm. long, the margins broadly white-hyaline, the apex abruptly acute or broadly scarious and truncate or emarginate with excurrent midvein: interior scales equaling the inner bract or nearly so: flowers 3–7, small, on almost hair-like flexuously exserted pedicels about 15 mm. long: perianth apparently about 8 mm. long, color faded out; stamineal column 4 mm. high: capsules undeveloped.

Texas, May, 1839, Dr. Ridell. In Herb. Dr. Chas. Mohr.

Sisyrinchium scabrellum

Caespitose in close erect tufts, arising from a dense cluster of fibrous roots, 25–40 cm. high, slightly fibrillose at base; dull pale green and glaucescent, the spathes often yellowish green and purplish, the rather long sheathing bases of the leaves purplish-tinged. Leaves stiffly erect, three quarters the height of the stem, very narrow, 1–2 mm. wide, tapering and cuspidate-acute, closely striate, scabrous all over or even canescently incrustate with minute setulose papillae, less so or quite smooth above, sometimes nearly smooth throughout: stems simple, stiff and slender, 1–2 mm. wide, flattened, sometimes glabrate but usually scabrous, at least below, sometimes equally so with the leaves, the finely-striate wing-margins roughened on the edges or even minutely hispidulous-aculeolate: spathes geminate at the top of the stem (in one instance three together) sessile or the outer one short-stipitate, the bracts herbaceous and striate, encrusted with minute whitish points or almost hispidulous-scabrous; primary bract stiff and erect, much elongated, 3.5–11.5 cm. long, slenderly attenuate, or broadened and foliaceous above the spathe, usually smooth or nearly so above; inferior outer bract attenuate, often slenderly prolonged, 1.2–3.8 cm. long, surpassing the inner bracts, which are less herbaceous, scarious-margined and acute or mucronulate; interior scales shorter than the inner bracts: flowers 3–6, pale blue, on slender, loosely erect or flexuous, much exserted pedicels 1–2 cm. long; perianth delicately membranous, 8–12 mm. long; stamineal column 4–6 mm. high. Mature fruit not seen.

North Carolina: Buncombe County, near Biltmore, May 10, 1898, in full flower, ex. Biltmore Herbarium; Stanley County, at the Falls of the Yadkin River, April 20–24, 1896, just in flower. John K. Small.

Dr. Small's specimens are darker green and much less scabrous than those from Biltmore, with larger and more foliaceous primary bracts and thicker roots.

Revision of the Genus Guardiola

By B. L. Robinson

The small and natural genus *Guardiola* extends from the mountains of southern Arizona to southern central Mexico. Its Mexican distribution is a peculiar one. Well represented in the northwestern states of Sonora, Chihuahua, and Tepic, it passes southeastward to the state of Vera Cruz on the Gulf, but is as yet unknown in northeastern Mexico and, what is more surprising, appears to form no part of the rich and varied vegetation of the southwestern states of Oaxaca and Guerrero. The genus is well marked among the melampodioid Compositae by its peculiar habit, cylindrical heads, broad thin scarcely herbaceous much imbricated involucral scales, and characteristic columnar achenes. Mexican material of the genus has of late been accumulating rapidly at the Gray Herbarium and the impossibility of bringing the diverse forms satisfactorily under the four or five hitherto recognized species has led to the preparation of the present synopsis.

The material of *G. Tulocarpus* now at hand shows that Dr. Gray's varieties *arguta* and *angustifolia* are too remote to make intergradation likely, and they are accordingly here treated as independent species.

Synopsis of the Species

* Involucral scales dorsally convex but not carinate: leaves broadly ovate to rotund, cordate at the base.

+ Heads large (for the genus) and few, in terminal umbelliform cymes, these exceeded in length by the subtending foliaceous bracts: leaves suborbicular, closely sessile.

1. G. ROTUNDIFOLIA Robinson, Proc. Am. Acad. **29**: 317.

Hills near Tequila, Jalisco, *Pringle*, no. 4571. Type in herb. Gray.

++ Heads of medium size, often numerous, the cymes exceeding the rather small subtending bracts: leaves ovate, sessile or subsessile, shallowly cordate.

2. G. PLATYPHYLLA Gray, Pl. Wright. **2**: 91.

Arizona, by streams, Sta. Catalina Mountains, *Pringle*; Wash of El Rialta, *Lemmon*; Sonora, *Wright*, no. 1236 (type, in herb. Gray); *Thurber*, no. 999; *Schott*; *Palmer*, no. 280 (coll. of 1890);

Hartman, nos. 124, 270; *F. E. Lloyd*, no. 420; S.W. Chihuahua. *Palmer*, no. 35 (coll. of 1885).

+ + + Heads few and large, in umbelliform clusters at the ends of the branches, the subtending bracts almost as large as the foliar leaves: leaves petiolate, subreniform-ovate, deeply cordate.

3. **G. Rosei** sp. nov.

Slender glabrous and glaucous perennial, 3–4 dm. high: stems terete, striate; branches opposite: petioles 6–8 mm. long; leaves subreniform-ovate, coarsely cuspidate-dentate, 3-nerved from the base, 4–5.5 cm. long, 3–4.8 cm. broad, bright green above, glaucous beneath, acutish and cuspidate at the tip, cordate with a rather deep open sinus at the base; the floral leaves scarcely smaller; 3-headed terminal cymes surpassed by their subtending bracts; pedicels glabrous, glaucous, 1–2 cm. long; involucral scales oblong, obtuse, 1.3 cm. long, 5 mm. broad: ray-flowers about 3; ligules oblong, white, 4 mm. long, the slender tubes 6 mm. in length: achenes moderately compressed, upwardly villous under a lens, at maturity 6 mm. long, fuscous, minutely mottled; disk flowers 4–5-parted.

Collected between Sta. Gertrudis and Sta. Teresa, Tepic, Mexico, by Dr. J. N. Rose, 8 August, 1897, no. 2078, and 96 km. south of Guadalupe y Calvo, S. W. Chihuahua, altitude 2300–2600 m., by E. W. Nelson, August, 1898, no. 4806. Types in herb. Gray and herb. U. S. Nat. Museum.

* * Outer involucral scales carinate.

4. **G. carinata** sp. nov.

Branched slightly lignescent perennial, finely ciliated upon the young petioles, otherwise glabrous: stem slender, terete, glaucous: petioles about 1.3 cm. long, glabrate: leaves lance-oblong, subhastately angled or toothed on either side the subcordate base, finely serrate with incurved cartilaginous-tipped teeth, scarcely pale beneath, 3–4 cm. long, 1.8–2.2 cm. broad: pedicels 7–9 mm. long, axillary or cymose at the ends of the branches; involucres in anthesis 1.1 cm. long; scales ovate, obtuse to acuminate, the 3 outer ones strongly carinate: ray-flowers much later in their development than the disk-flowers, the heads thus proterandrous: ligules minute: achenes pale, subterete, 6 mm. long, upwardly villous under a lens, minutely mottled.

Collected by Dr. J. N. Rose at Acaponeta, Tepic, Mexico, 23 June, 1897, no. 1498. Well marked by its carinate involucral scales, which are not found elsewhere in the genus. Types in herb. Gray and herb. U. S. Nat. Museum.

* * * Involucral scales dorsally convex but not carinate; leaves lance-oblong to linear, petioled.

+ Leaves cordate or subcordate at the hastately lobed base, coarsely toothed.

5. **G. odontophylla** sp. nov.

Glabrous, somewhat glaucous: stem terete, purple, striate, branched: petioles 8–10 mm. long; leaves lance-oblong, coarsely and somewhat doubly dentate, 5 cm. long, 2.2 cm. broad at the hastately bilobed base, green on both sides, the teeth rather broad, spreading, scarcely at all incurved, acutish to acuminate; the floral leaves scarcely reduced, bearing elongated basal lobes: heads subumbellate by 2's and 3's at the ends of the branches; pedicels 3–4 mm. long; involucral scales lance-oblong, acute, 1 cm. long: achenes ashy, punctate, upwardly villous under a lens, compressed, 7 mm. long.

Collected by E. W. Nelson between Ramos and Inde, Durango, 11 to 14 August, 1898, no. 4683. Types in herb. Gray and herb. U. S. Nat. Museum.

+ + Leaves cuneate or obtuse at the base.

++ Heads relatively broad; involucres 4 mm. thick; pedicels 3–14 mm. long: leaves (with rare exceptions) hastately toothed at the base; the floral leaves considerably exceeding the cymes.

= Leaves serrate with close incurved teeth.

6. G. Mexicana Humb. & Bonpl. Pl. Aeq. **1**: 144, *t. 41*; HBK. Nov. Gen. et Spec. **4**: 247; Gray, Pl. Wright, **1**: 111.

G. atriplicifolia Gray, l. c.

Michoacan, *Humboldt & Bonpland*, *Pringle*, no. 4167; Jalisco, *Palmer*, no. 214 (coll. of 1886), *Pringle*, no. 3484; Zacatecas, *Rose*, no. 2737; Morelia, *Galeotti*, no. 2418; Mirador, *Sartorius*; Morelos, *Pringle*, no. 6184; Volcano of Toluca, *Heller*, no. 443.

A portion of Galeotti's no. 2418 (the type number of *G. artiplicifolia* Gray) in herb. Gray so closely matches the perennial specimens of *G. Mexicana* that, although originally described as an annual, it seems undoubtedly this species, to which, in fact, Dr. Gray himself later reduced it (Proc. Am. Acad. **22**: 423).

= = Leaves dentate; teeth very sharp, spreading.

7. **G. arguta** (Gray)

G. Tulocarpus var. *arguta* Gray, Proc. Am. Acad. **21**: 387.

Chihuahua, *Pringle*, rocky hills near the town of Chihuahua, no. 678 (type in herb. Gray), also in foothills of the Sierra Madre, no. 1281. This species differs from *G. Tulocarpus* in its large heads and conspicuously elongated bracts, as well as in the differently toothed leaves.

++ ++ Heads smaller, numerous; involucres 2.7 to 3 mm. in thickness: leaves not hastately toothed at the base: pedicels 1 to 2 (or rarely 4) mm. long.

= Upper bracts of the inflorescence elongated, surpassing the heads: leaves narrowly lanceolate to linear.

8. **G. angustifolia** (Gray)

G. Tulocarpus var. *angustifolia* Gray in Wats. Proc. Am. Acad. **22**: 423.

Copiously and cymosely branched, 4–6 dm. high; petioles 8 mm. long; leaves narrowly lanceolate to linear, scarcely paler beneath, serrate with five incurved callous-tipped teeth, not hastately toothed at the cuneate base, 7–8 cm. long, 1.2–1.4 cm. broad; heads numerous in small umbelliform, about 5-headed cymes; pedicels very short, 1–3 mm. long; involucres 7 mm. long, less than 3 mm. in diameter; scales acute: achenes gray, mottled, upwardly villous under a lens, 6 mm. long including the sterile base.

Jalisco, ravines near Tequila, *Palmer*, no 360 (type in herb. Gray), and on hillsides near Guadalajara, *Pringle*, no. 1737.

Differs from *G. Tulocarpus* not only in the form of the leaves but in the length of the bracts and general character of the inflorescence.

= = Upper bracts very small, much shorter than the heads: leaves lance-oblong.

9. G. TULOCARPUS Gray, Pl. Wright, **1**: 111.

Tulocarpus Mexicanus Hook. & Arn., Bot. Beech. 299, *t. 63*.

Tepic, *Lay & Collie*; Zapelote, State of Tepic, *Lamb*, no. 580; between the city of Mexico and Mazatlan, *Gregg*, no. 585; Colima, *Palmer*, no. 1198 (coll. of 1891).

Readily recognized by its numerous small heads in close compounded small-bracteal cymes.

GRAY HERBARIUM OF HARVARD UNIVERSITY.

New Plants from Wyoming. VII

By Aven Nelson

For the past several years I have been observing the species of *Paronychia* with some care, and a large series of specimens have been secured to illustrate those credited to this region. Among those secured are authentic specimens of *Paronychia depressa* (T. & G.) Nutt. That Nuttall's plant deserves specific rank I think can hardly be questioned by one familiar with it in the field. Nuttall, in selecting the name *depressa*, must have fully understood its habit, but it seems that no one since has appreciated the appropriateness of the name. The descriptions of it that are current are all misleading. Height is assigned to the stems but they are absolutely prostrate-spreading, forming close mats upon the surface of the ground, a fact that herbarium specimens fail to show. This will at once separate it from that species with which it has been associated, though they are also otherwise very different. To place it on record a little more fully than has heretofore been done the following characters may be noted :

Prostrate-spreading, forming close mats, the very numerous dichotomous stems springing in a cluster from the summit of a woody root, all but the herbaceous portion buried in the loose soil, silvery, this appearance due to the large scarious stipules and the short, silvery, scabrous pubescence : leaves linear, exceeding the internodes, cuspidate or mostly bristle pointed, the lanceolate stipules more conspicuous than the leaves (which they nearly equal) and with them closely clothing the short stems : flowers singly in the axils or in small cymes, nearly sessile, surpassed by the subtending leaves and bracts : sepals with a cone-shaped tip half as long as the rest of the sepal, awn about equaling the tip, at the base of which the arch at the inner face is borne : filaments very short, exceeded by the slender staminodia.

This I have secured but once and I am sure it is not common. My no. 461 has been compared with the type in Torrey Herb. at Columbia, by Dr. Rydberg, who says it is a very close duplicate of Nuttall's specimen.

Of frequent occurrence in Wyoming is *Paronychia sessiliflora*

Nutt. but of this there are two or three forms, one of which seems sufficiently well marked to be constituted a variety.

Paronychia sessiliflora brevicuspis

Smaller than the species, more closely matted, the leaves shorter, the lower ones obtuse: the herbaceous part of the branches very short: flowers in numerous small cymes, clustered at the ends of the branches, nearly immersed in the leaves: calyx about 2 mm. long, with a swollen turbinate base: sepals closely valvate, forming a short cylindrical tube closed at the summit by their arched tips, the tip and awn very short.

Not plentiful, but occurring occasionally on open, stony ridges in the hills. No. 349, Laramie Hills, July 7, 1894, well represents this variety.

Paronychia Jamesii T. & G. has sometimes been reported from this range, but it seems probable that most of the specimens so-called belong rather to the following species.

Paronychia diffusa

Allied to *P. Jamesii* but wholly prostrate-spreading: the woody root vertical, the numerous branched stems crowded on its crown: stems widely spreading, their perennial portion buried in the soil, the herbaceous portion short, very leafy: leaves equaling or exceeding the internodes, narrowly linear, mostly acute and mucronate: stipules silvery, lanceolate, shorter than the leaves: influorescence contracted, the numerous small cymes congested at the ends of the short, brittle stems: flowers nearly sessile, exceeding the bracts and most of the leaves: sepals minutely puberulent as are also the leaves and stem, the short turbinate base of the calyx minutely hirsute: cusps short, arched within: filaments short, exceeding the staminodia.

This is the commonest species in this genus in this range. The following numbers well represent it: 451, 1331, 2103 and 2769.

Besides the foregoing *P. pulvinata* Gray occurs on some of the Alpine summits in our mountains.

Draba surculifera

Perennial, root short, bearing on its crown a few to several erect, simple stems and some short leafy stolons: stems slender, strict, 2–3 dm. high, pubescent with scattering, simple hairs and a closer branched puberulence: leaves of the crowns and the stolons crowded, oblanceolate, short-petioled or nearly sessile, 3–5 cm. long, 5–10 mm. broad, cinereous with a close stellate pubescence or glabrate: upper stem leaves ovate or broadly lanceolate, acuminate, sessile by a broad or partly clasping base, sub-glabrous, downward gradually passing into the basal leaves: fruiting raceme constituting ⅓–½ of the whole length of the stem, naked above, the lower pods in the axils of the upper leaves: flowers yellow, rather small: sepals glabrous or nearly so, ovate: petals obovate, narrowed into a slender claw, nearly twice as long as the sepals: filaments exceeding the sepals, rather stout, anthers small: pod lanceolate, 8–12 mm. long, finely pubescent, usually flat but occasionally twisted: style rather thick, about 1 mm. long: pedicels slightly shorter than the pod: seeds 16–20.

This species may possibly be found in some of the herbaria as one of the forms of the Rocky Mountain aggregate that has been called *D. aurea* Vahl. The true *D. aurea*, if figures and descriptions may be relied upon, has a single stem, corymbosely branched above: *D. surculifera* has several unbranched stems and some short, stoloniferous shoots. Of the several species recently published by Dr. Greene, only two are closely allied to this, viz. *D. Neo-Mexicana* (Pittonia, **4**: 18) which is separated by its stellate-pubescent calyx, its glabrous, elliptical pods and its long style and probably other characters that would appear were that before me: *D. spectabilis*, which is separated from this by its showy flowers and differences of fruit. In some respects, *D. Herleriana* resembles this but its branching stems and narrow twisted pods make it impossible to unite the two.

Type specimen no. 5125, La Plata Mines, Medicine Bow Mts., by Mr. Elias Nelson.

Lesquerella condensata

Perennial, the several branches of the caudex very short and crowded (in loose, sandy soil more open and sheathed by the dead leaf bases), the whole plant both in flower and fruit forming a small, dense, sub-globose tuft, 3–8 cm. in diameter, finely and densely stellate-pubescent throughout: leaves greatly crowded on the crowns, linear or narrowly oblanceolate, 1–4 cm. long: infloresence a short, corymbose raceme, about equaling (rarely exceeding) the leaves: petals broadly spatulate or with an elliptic blade, 6–7 mm. long, about half exceeding the sepals, the claw broad and margined: filaments slender, equaling the sepals, slightly enlarged at base: pod ovate, compressed at summit, 5 mm. long, about equaling the slender style: ovules two in each cell, usually only one maturing; septum generally perforated by a narrow slit.

Probably most nearly allied to *L. alpina* (Nutt.) S. Wats. which seems to be a very rare plant. From this its compact, tufted, stemless habit separates it, as does also its smaller flowers and short racemes and few-seeded pod.

This is one of the first plants to come into blossom on the Laramie Plains, its bright yellow showing on some of the naked, rocky slopes of the foothills in mid April. It seems to occur in similar situations throughout the southern part of the state. Collected a number of times and, on the determination of others, distributed as *Draba glacialis* Adams., a most unaccountable error. Some of our collection numbers of it are 62, 1218, 3071, 4324 and 4797, the latter number unusually large in every way.

Cerastium Buffumae

Perennial (?), stems densely clustered on the crown of a slender root, closely leafy-matted and spreading, light or yellowish green: the numerous stems spreading or ascending, 7–15 cm. long, minutely glandular-pubescent, the internodes gradually longer upwards and less conspicuously leafy: leaves small, very numerous below, oblong to elliptic, sessile or tapering to a broad, petiole-like base, 5–12 mm. long: inflorescence strict and fascicled, the lower pedicels elongated: pedicels and calyx closely glandular-puberulent: sepals green, barely scarious margined at the tip, oblong, obtusish, 4–5 mm. long: petals one half exceeding the sepals (more or less), bifid: stamens ten: styles five: capsules when mature about twice as long as the sepals: seeds brown when mature, closely but minutely papillate.

In 1892 an extensive collection, mostly of grasses, was made by Professor B. C. Buffum for this University. Mrs. Buffum who accompanied the expedition collected most assiduously in other groups. Among the good things she secured was an abundant supply of this fine species from some locality in the Big Horn Mountains, the exact place not now known. It is with pleasure that I dedicate this species to its discoverer. Type specimen in Herbarium University of Wyoming.

Thermopsis annulocarpa

Perennial from horizontal rootstocks, silvery pubescent throughout with short, soft, appressed hairs: stems single, or two (possibly more) from the crown of each rhizome, 3–4 dm. high, simple below, branched above, the branches slender, leafy, barren, exceeding the single mature raceme: leaves elliptic, oblong or broadly oblanceolate, mostly obtuse, 3–5 cm. long; stipules broadly ovate or rhombic below, narrower upward, the upper oblong, 2–3 cm. long; petioles about as long as the stipules: raceme strictly terminal on the main axis: calyx-tube campanulate, somewhat nerved at the base, 5 mm. long, the lobes shorter: corolla unknown: mature pods pubescent, 12–15 cm. long, about 7 mm. broad, circularly curved, usually forming a complete ring or the apex even overlapping the base: seeds 7–10; the ovules somewhat more numerous.

That it should be necessary to establish a third species in this genus, from this state within a year, is a little singular but this plant differs so radically that it can not be disposed of satisfactorily in any other manner. In habit and pubescence it suggests *T. argentata* Greene but in fruit character it is nearer *T. rhombifolia* Rich. though its circularly curved pod makes it distinct enough from that. Then too the habitat of this is exceptional. While not strictly alpine yet it is more than sub-alpine. It was secured in the Ferris Mountains, among the rocks on the naked slopes near their summits, at an altitude of fully 10,000 feet.

Type no. 4971, by Mr. Elias Nelson, July 25, 1898.

Anogra rhizomata

Perennial: rhizome horizontal, long, semi-woody, moderately thick, giving rise at intervals to short, obliquely ascending branches: stems several, from the crowns of the branches of the rhizome, divaricate-ascending, 1–2 dm. long, from pinkish to light violet, puberulent: leaves from nearly entire to deeply pinnatifid, linear-oblong in outline, the lower somewhat petioled, 3–5 cm. long, more or less hispid-ciliate and puberulent: flowers axillary, congested at the summit of the stems; buds acute at apex, sometimes glabrate: calyx tips free, lobes shorter than the petals, usually much shorter than the tube, throat not villous: petals white or pink, sub-orbicular: capsule linear, somewhat angled, scarcely tapering to the apex, 2–3 cm. long, divergent or becoming deflexed.

This and *A. albicaulis* resemble each other greatly in general aspect but the remarkable rhizome of the one is to be contrasted with the slender, vertical taproot of the other. The obtuse buds and small, tapering capsule of the larger plant is to be contrasted with the acute buds and long, prismatic-cylindrical capsules of the smaller, perennial plant.

Cymopterus bulbosus

Root large, clavate, increasing in diameter downward, the end usually bulbous, 10–15 cm. long, 2–4 cm. in diameter in thickest part: caudex very short, covered with the bases of the petioles of dead leaves: leaves 1 or more from the caudex and several on the stems (the former long petioled), glaucous, bipinnate, ovate in outline, 4–7 cm. long; the pinnae also ovate, pinnatifid or toothed, the ultimate segments oblong to ovate, 3–8 mm. long; petioles with expanded membranous base: stems 1–2 from the crown, slender, 3–5 cm. long, giving rise at their summits to several leaves and peduncles: peduncles moderately stout, at maturity 5–10 cm. long and equaling or exceeding the leaves: involucre and involucels of broad membranous bracts with broad greenish midrib, more or less united at base: rays unequal, 8–15 mm. long, those of the aborted umbellets very short; pedicels 5–8 mm. long: fruit elliptic to oval, 8–14 mm. long, 6–10 mm. wide; wings broad and thin, equaling or narrower than the seed body, the dorsal or the two intermediates occasionally not developed: oil tubes mostly 3 in the intervals and 6 on the face, the two middle ones situated near the inner side of the integument: seed face concave.

That this species may exist in the herbaria as *C. montanus* Nutt., is possible but no two related species are more easily discriminated. In *C. montanus* the peduncles are very short, shorter than the leaves in both flower and fruit; the leaf segments are rather distant while in *C. bulbosus* the segments are crowded. The large bulbous termination of the root will further distinguish the latter as do also the thin integument and thin wings (which are scarcely thickened at the base) in contrast with the conspicuously thickened integument and base of the wings of the other. If more points are needed the habitat is also discriminative. *C. montanus* is of the open plains of the Rocky Mountain region in general while the other seems to be confined to naked, clay soil, such as occurs in the ravines and slopes among the Green River shales. Type specimen in Herb. University of Wyoming, no.

4709, June 14, 1898. Also collected in 1897 at Point of Rocks no. 3085.

Pentstemon Utahensis (Wats.)

P. glaber Utahensis Wats. Bot. King, 217.

Dr. Watson placed this as a variety because there were seemingly intermediate forms connecting this with related species. The several authentic specimens of it at hand from various parts of the Rocky Mountains show certainly as much constancy in characters as any of the recognized species. Its tall, strict stems, with long internodes and erect, relatively narrow leaves; its rather crowded, long petioled basal leaves, and its greatly elongated inflorescence puts it in sharp contrast to *P. glaber* Pursh.

Of the more recent collections that well illustrate its characters are Baker, Earle and Tracy's specimens from Mancos, Colo., no. 405 and the writer's nos. 1093, 1559 and 4102, from various parts of Wyoming.

Phacelia campestris

Annual, minutely pubescent, scarcely glandular, branched from the base, the 2–6 main branches decumbently divaricate at base, these more or less branched and with ascending tips, main branches 8–12 cm. long: leaves oblong in outline, 1.5–3 cm. long (including the short petiole), deeply pinnatifid, the 3–5 pairs of segments oblong, obtuse, entire; the terminal lobe usually three-toothed: raceme simple, at first short and crowded, later open, the few flowers (6–12) rather uniformly distributed on the 4–7 cm. long rachis: pedicels very short: sepals oblong or narrowly spatulate, minutely hispid on the margins, in anthesis a third longer than the corolla, lengthening slightly in fruit: corolla white, 2–3 mm. long, short tubular, the rounded lobes $\frac{2}{5}$ of its whole length, appendages very narrow: filaments dilated downward, about the length of the corolla-tube, subequal: style equaling or shorter than the ovary, much shorter than the mature capsule, divided one half its length: capsule finely pubescent, oblong, obtuse, 3–4 mm. long, a little shorter than the sepals: seeds 10–14, elliptic, compressed, transversely ridged.

To be compared with *P. Ivesiana* Torr. from which it differs in being much less glandular, in having a corolla shorter than the calyx, nearly equal stamens and fewer seeds.

It was secured on the open plains, in loose sandy soil about the roots of sage-brush, near Granger, June 14, 1898, no. 4696.

Lappula cenchrusoides

Annual, rather intricately bushy-branched, 2–4 cm. high: stems and branches rather slender: pubesence moderately harsh, rather minute, that of the stems of short, appressed, whitish hairs with inconspicuous pustulate bases,--of the leaves somewhat similar, scanty on the upper face, denser below with inordinately large pustulate bases: leaves numerous, small, oblong to ovate, 1–2 cm. long: flowers in leafy-bracted spikes, very minute: the lobes of the corolla obtuse, suborbicular, slightly shorter than the tube which about equals the calyx: nutlets large, ovate-acute, nearly sessile, not deflexed, minutely papillose-tuberculate on the back, the larger of the tubercles in a median row, armed on the margins with a double row of bristles; bristles glochidiate-barbed at the apex only, somewhat unequal, mostly distinct to the base.

This was found in considerable abundance in a dry cañon, among the rocks, mostly in clumps. The very abundant sandbur-like fruits at once attracted attention and closer examination shows many points of difference between this and *L. Texana* (Scheele) Britt. which is so abundant in this range.

Type specimen in Herb. University of Wyoming, no. 5339, Laramie Hills, September 14, 1898.

Mertensia foliosa

Rootstock vertical, short, thick, covered with dead brown bark, usually branched at summit, the 1–several crowns clothed with the bases of dead petioles: roots slender, fibrous, intermingled with a few large woody ones: stems 1 or more from each crown, simple, ascending or erect, striate, glabrous or minutely pruinose, 2–3 dm. high, leaves thick, ample, glabrous, minutely scabrous on the margins: radical leaves numerous, elliptic to oblong, 4–7 cm. long, slender petioles once or twice as long: cauline crowded, sessile, oblanceolate or (upwardly) lanceolate and acute: the foliar bracts lanceolate: panicle rather crowded, the lower peduncles but little elongated: corolla rather large, about 15 mm. long, the tube slightly exceeding the limb, about twice the length of the lanceolate sepals; the crests in the throat between the bases of the filaments conspicuous, a 10-toothed ring at the base of the tube, glabrous throughout: filaments as broad or broader than the anthers: anthers (in all specimens examined) exserted *i. e.*, outside of the tube.

Recently distributed under no. 2951 as *M. oblongifolia* which it is far from being. It is the prevailing species in southwest

Wyoming on the sage-brush slopes in the foothills. The dense, leafy clumps are both numerous and conspicuous. Observed and collected in several localities, but the before mentioned number from Evanston, May 28, 1897, is designated as typical.

Mertensia viridis

M. lanceolata viridis Aven Nelson, First Rep. Fl. of Wyo. 158.

Rootstocks woody, creeping in the crevices among the rocks; the crowns sheathed by the dead petioles: stems one or more from each crown, glabrous or sparsely hispidulous, decumbent at base, slender and rather weak, 2–4 dm. long: leaves bright green, glabrous below, minutely hispidulous above: radical numerous, 4–6 cm. long, from oblong to elliptic, on slender petioles about twice as long as the blade: cauline oblong, becoming smaller and acutish upward: panicle leafy bracteate, many-flowered: peduncles and pedicels slender, the former surpassing the foliose bracts: corolla about 1 cm. long, the tube exceeding the limb and about twice the length of the sepals: filaments narrower than the anthers.

Since the publication of this plant as a variety of *M. lanceolata* DC. it has been collected once more, this time near Dome Lake at the summit of the Big Horn mountains, no. 2430. These latter plants show that it is a good species. It is strictly alpine. The original collection is no. 1608, Laramie Peak, 1895.

Lithospermum asperum

Perennial: root large, woody, deep-set, the dark bark exfoliating in thin flakes: caudex rather numerously and slender branched, dark brown with scale-like leaves and exfoliating bark: herbaceous stems numerous, slender, rather brittle, simple or branched, 15–25 cm. long, hirsute, the short whitish hairs divaricate: leaves rather numerous, from oblong to linear, the broader tapering to a narrow base, all sessile or nearly so, 2–4 cm. long, rough hirsute, rather sparsely so, especially on the upper surface, the hairs short, tapering from a pustulate base: flowers on short, very hispid pedicels, axillary: sepals linear, about 5 mm. long: corolla yellow, tube long, 2–3 cm., lobes oval, crenulate-erose, about $\frac{1}{4}$ as long as the tube, crests rather small: stamens inserted about $\frac{1}{6}$ the length of the tube below the throat: nutlets as in section Batschia Endl., not impressed-punctate (if at all sparingly and minutely so on the ventral side only).

Having but one collection of this I am unable to state whether it produces more than one form of flowers or not. Since mature nutlets were secured on the same plants with the conspicuous flowers it seems probable that no cleistogamous ones are produced. That dimorphism, as to the insertion of stamens, probably exists here as in the rest of the section seems likely.

The most nearly allied species is undoubtedly *L. angustifolium* Michx., but in the rather numerous synonomy of that somewhat polymorphous species I find nothing to indicate that the plant now under consideration has ever been included. This will be distinguished at once from that by the harsh pubescence, the root character, the non-punctate nutlets and its habitat. Though collected but once it was observed carefully in its locality where it was abundant: found only on abrupt, shelving slopes of sandstone. Type, no. 4737, Point of Rocks, June 13, 1898.

Castilleia chromosa

Stems usually numerous, clustered on the crown (or crowns) of a woody root, simple or sparingly branched, ascending or erect with somewhat decumbent base, 2–4 dm. long: pubescence of two kinds, a fine puberulence and more or less of whitish, crisped hairs: leaves variable; the lower entire or nearly so, lanceolate to linear, 3–7 cm. long; the upper pinnatifid, consisting of a lanceolate blade proper, 3–5 cm. long, and 2–4 linear to lanceolate, widely divaricate or ascending lobes; the lobes subacute, somewhat paired, the upper pair short, the lower about equaling in length the blade proper: inflorescence at first short and dense, at length more open-spicate, 10–15 cm. long, more densely crisped-hairy than the rest of the plant: bracts somewhat similar to the upper leaves, the lobes less divaricate, about equaling the corolla, from scarlet to yellowish-red: calyx about 20 mm. long, about equally cleft before and behind, the tube about twice as long as the bifid lobes: corolla more or less exserted, sometimes one fourth exceeding the calyx, the galea a little longer than the tube, the lip very short and almost truncate, three narrow plicae extending from its margin nearly one third the length of the tube.

At first I was inclined to think this merely a form of *C. angustifolia* Don. but after careful study of all the material at hand in the light of Mr. Fernald's excellent presentation of this and the allied species * I feel satisfied of the perfect distinctness of *C. chromosa*. I am even inclined to think that *C. angustifolia* will be found to belong to a range considerably to the northwest of this.

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* Erythea, **6**: 41.

C. chromosa is widely distributed in the desert region of south-central Wyoming and several collections of it show no remarkable variation. The following are some of the collections of it: Leroy, Uinta Co., no. 4577, June 7, 1898; Green River, Sweetwater Co., no. 4721, June 14, 1898; Ft. Steele, Carbon Co., no. 5380, June 18, 1898.

Erigeron pinnatisectus (Gray)

E. compositus pinnatisectus Gray, Proc. Am. Acad., **16**: 90.

To regard this longer as a variety of *E. compositus* is simply to keep up a cumbersome nomenclature that is neither necessary nor justified by the plant. There are sufficient forms that must of necessity be held as varieties of that species, without including a form so decidedly at variance with the others. *E. pinnatisectus* in its comparatively simple root-system; its fewer, glabrate leaves and stems; its pinnately dissected leaves, and its numerous, long, purple rays is strongly in contrast with the tufted, compact habit; the trifid or multifid leaves; the rather conspicuous pubescence, and the white rays of the other.

E. pinnatisectus mostly occurs at higher altitudes than *E. compositus* and consequently is less frequently collected but, nevertheless, it is fairly well represented in the herbaria. Professor C. S. Crandall's specimens from the head waters of Beaver Creek, Colo., and the writer's no. 1816, LaPlata Mines, Medicine Bow Mountains, well illustrate it.

Erigeron melanocephalus

E. uniflorus L. of most American authors, in part; *E. simplex* Greene, Fl. Fran. 387, in part (?); *E. uniflorus melanocephalus* Aven Nelson, First Rep. Fl. Wyo. 131 and 206.

Main root woody, more or less branched, giving rise to numerous fibrous ones: caudex thick and nearly simple or more or less branched, the branches short: stems few to several (often 10 or more), slender, erect, 5–15 cm. high, monocephalous, pubescent with purplish hairs: leaves numerous on the crowns, nearly sessile to long-petioled, blade elliptic to narrowly oblong, 2–5 cm. long (including the petiole), almost glabrous; stem leaves several, broadly linear, acuminate, 2–3 cm. long, pubescence similar to that of the stem: heads large, when fully expanded 3 cm. broad: involucral bracts involved in a dense, dark-purple wool, the hairs of which consist of purple and transparent cells alternately arranged: rays 50–60, white or barely pinkish: disk flowers very numerous, all of them perfect.

By separating the American forms from the Old World *E. uniflorus*, Dr. Greene has simplified the study of the American species. It seems to me that *E. simplex* is still an aggregate. As characterized by Dr. Greene, "Stem solitary, simple, involucre densely villous-hirsute," the form now proposed as a species is excluded. *E. melanocephalus* shows a constant tendency to a caespitose habit and several stems: its dark, almost black, involucres are strongly in contrast to the light colored ones of *E. simplex.* The fact that the very numerous florets of the disk are all perfect seems also to be in disagreement with *E. simplex*, as it is most frequently described. Both species occur in the Rockies but the latter has the wider range and is, I believe, alpine while *E. melanocephalus* is mostly alpestrine, occurring in the small, grassy parks below or near the timber line. Undoubtedly many of the collections from the Rockies belong to this species. Our numbers, 1772 and 5180 from the LaPlata Mines, Medicine Bow Mountains well illustrate it.

Erigeron Engelmanni

Root single, short, tapering rapidly, woody, more or less branched below: crown woody, from nearly simple to numerously but very short branched: leaves very numerous, crowded on the crowns, linear, on very slender petioles which about equal the blade, closely sub-cinereous, somewhat ciliolate on the petioles, from 2–6 cm. long (including the petioles): stems weak, decumbent or prostrate, moderately leafy, pubescence similar to that of the leaves, 3–6 cm. long, monocephalous or with 2 or 3 heads: peduncles short, ascending, 1 or more bracted: heads rather small, involucre about 5 mm. high, its bracts equal, in two series, narrowly linear, acuminate, dark green with light margins, ciliolate: rays white, broadly linear, 40 (more or less), the ligules about 5 mm. long, equal: achene small, obscurely pubescent.

In looking through the "inquirendi" sheet of *Erigeron* in Herb. Mo. Bot. Garden, I found just one specimen of this plant collected by Dr. Geo. E. Engelmann, June 26, 1880, at Evanston, Wyo. My no. 5389, which I cite as type, is from the same locality, June 19, 1898, and is a perfect duplicate of Engelmann's. The habitat of this species seems to be the stony slopes of the foothills where each plant forms a flat, spreading mat among the stones. Its affinities, I should think, are with *E. Eatoni.*

Erigeron inamoenus

Caespitose, the roots numerous, one or more short tap-roots and many fibrous ones: caudex of few to many short crowded branches: leaves numerous, fascicled on the crowns, linear-spatulate, pubescent with short, stiffish hairs, 2–4 cm. long, including the slender, ciliolate petiole which is nearly twice the length of the blade: stems scapose, pubescent, 5–10 cm. long, the 3–5 basal leaves not apparent as they are concealed by the similar fascicled ones of the crowns, a single bract on the monocephalous peduncles: involucre broad-campanulate, about 6 mm. high, ciliolate-pubescent; bracts linear, acuminate, with a dark green midrib and scarious margins: rays purple, 25 more or less, broadly linear to oblong, the ligule 7–10 mm. long, the tube short: pappus bristles slender, in one series, about equal: achenes pubescent.

A beautiful species with a very characteristic root system and large (for the plant) handsome heads of flowers. Secured but once, when it was found in the greatest profusion, literally carpeting the whole rounded summits of low hills otherwise destitute of vegetation. The soil (?) was a red clay and pebbles as large as birds' eggs, mostly pebbles. Type specimen in Herb. University of Wyoming, no. 4680, Kemerer, June 13, 1898.

Erigeron Wyomingensis

Root nearly simple, woody: caudex multicipal, the branches very short and crowded, covered with dead leaf-bases: stems simple, numerous, one to several from each crown, rather closely pubescent with spreading unequal hairs, leafy below, naked-pedunculate above, 7–15 cm. long: leaves crowded on the crowns, short hirsute all over, the margins stongly hirsute-ciliate especially on the petioles, linear-spatulate, on petioles exceeding the blades, 3–5 cm. long (including petiole): stem leaves several, similar but becoming smaller upward: peduncles naked or with a filiform bract, monocephalous: heads large, including the spreading rays 20–25 mm. broad: involucral bracts narrow, in two rows, hirsute, long acuminate, with a dark green midrib, half as long as the rays: rays purple, 40–70, pappus of sparse, slender bristles, equaling the numerous disk corollas and a close ring of short, unequal, paleae-like hairs: achene pubescent, glabrate at maturity, oblong-spatulate, 2–3 mm. long.

This species has much the habit and pubescence of *E. pumilus* Nutt. but its smaller size, simple, less leafy stems, long peduncled heads and purple rays at once distinguish it.

It is also to be compared to *E. condensatus* (Eaton) Greene, under which name some specimens were recently distributed, no. 3088, Point of Rocks, June 1, 1897. That is, however, a plant of a more southwestern range and seems to be a smaller plant, with shorter leaves, more coarsely hirsute, light colored rays and a very different pappus.

E. Wyomingensis I have seen so far from this state only. It occurs rather sparingly in the south-central portion of the state, on dry gravelly hillsides. Collected in 1898 also. Type in Herb. University of Wyoming, no. 3088.

WYOMINGIA

Perennials with woody, more or less branched roots and short, woody, caespitose, multicipital caudices whose branches are roughened or sheathed by the bases of the leaves of the previous years: stems simple, monocephalous, one or more from each crown, becoming naked and pedunculate above: leaves crowded on the crowns and on the bases of the stems: heads large, involucral bracts in 3–4 successively shorter rows, rigid with a thickened midrib: flowers Aster-like, rays broad, comparatively few, disk-flowers numerous: style appendages short, triangular-cuspidate: achenes short, densely pubescent, subterete.

Wyomingia pulcherrima (Heller)

Erigeron pulcherrimus Heller, Bull. Torr. Bot. Club, **25**: 200, *pl. 304*.

Mr. Heller's plant as the first published of the species upon which the genus now proposed as new is founded, may stand first. His species and the one collected by the writer (described below) are, so far as known at present, the only members of the genus. It may turn out, however, that with these are to be associated one or two others among which may be named *Erigeron Montanensis* Rydb.

The generic description is drawn in particular from the following species, though an examination of Mr. Heller's plant leaves no doubt whatever that the two are closely congeneric. To place these plants in the already diverse genus *Erigeron* would be very unsatisfactory as the characters show.

The root and caudex systems are those of *Xylorrhiza* and the broad rays also suggest that genus. *Wyomingia* is further to be distinguished from *Erigeron* by its multiserial involucre and the thickened rigid bracts; by the short, strongly pubescent achenes, which are scarcely flattened, and by its uniserial pappus. I had thought to call the genus *Helleria* in honor of that indefatigable collector, A. A. Heller, but that name being preoccupied I call it *Wyomingia* in honor of my own state.

Wyomingia cinerea

Characters of the genus: stems erect, fascicled, somewhat striate with yellowish-green lines (possibly a generic distinction), about 2 dm. high, the upper part naked, pedunculate, usually with a single bract: leaves linear or some of the crown leaves spatulate, acute, cinereous (as are also the stems) with a short, close, appressed pubescence: heads large, when fully open, 3 cm. or more across: involucre broadly hemispherical, about 1 cm. high, its bracts acute, cinereous with a spreading, crinkled pubescence; rays 30 (more or less), 5–7-nerved, white or pinkish, the tube finely pubescent as are also the disk florets, 3 mm. broad, 3-toothed at the rounded apex: pappus tawny, in a single series, about as long as the disk corollas, the bristles mostly abruptly flexed 1/3 their length below the apex: achene short, striately marked with 2–4 greenish-yellow lines, densely pubescent: receptacle flat, alveolate.

A handsome species and certainly rare. Collected on sterile, gravelly hillsides in the Platte River bluffs, near Ft. Steele, June 18, 1898, no. 4828. Very similar and probably the same as this is Professor C. S. Crandall's specimens from Grand Junction, Colo., distributed as *Erigeron argentatus* Gray. Type in Herb. University of Wyoming.

Elliot C. Howe, 1828-1899

By Charles H. Peck

Elliot C. Howe was born at Jamaica, Vermont, February 14, 1828. Coming to New York in early life he received his academic education in the academies of Troy and Lansingburg. Early in life he gave indications of a love for natural science and turned his attention to the study of geology, zoölogy and botany. Music also received a share of his attention and pharmacy had attractions for him. This soon led him to the broader field of physiology and medicine. He engaged in the study of medicine in New York City and while there did literary and reportorial work for the New York *Tribune*, then under the management of its celebrated editor, Horace Greeley. After receiving the degree M.D. he returned to Troy and commenced the practice of medicine. Here he remained three years, giving in that time such attention as he could to music and botany. He was leader of the choir of the Fifth Avenue Methodist Church until he was induced to leave Troy and enter the large and flourishing Charlotteville seminary as teacher of music, physiology and botany. Charlotteville swamp was in the vicinity of the seminary and it was soon made famous by his discovery in it of the beautiful American Jacob's ladder, *Polemonium Van Bruntiae* Britton. This is the first known New York locality for this plant which then was thought to be the same as the European *Polemonium coeruleum* L. The continuation of this school was abruptly terminated by the accidental burning of the seminary building. Dr. Howe then accepted a position in the Fort Edward Institute, where he taught music, botany and German. Here he became acquainted with Miss Emily Z. Sloan who was also a teacher in the institute and who afterward became his wife. While here he made many friends and engaged vigorously in the study of mosses. He also began the study of mycology and entered into correspondence with the late Rev. M. A. Curtis, of North Carolina, who at that time was the chief devotee and exponent of American mycology. Dr. Howe was the first

New York botanist to take up this study with earnest activity. After seven years he left Fort Edward and renewed the practice of medicine at New Baltimore, N. Y., but the field here was limited and he soon went to Yonkers, N. Y., where he took a prominent position in his profession. He was secretary of the Westchester County Homoeopathic Society for six years and its president for two years. While here he was able to make large additions to his herbarium and to make many new botanical acquaintances. He also became a member of the Torrey Botanical Club. After thirteen years of great activity in Yonkers, failing health, long resisted, compelled him to relinquish the practice of medicine, and fourteen years ago he removed to Lansingburg. As long as his health and strength permitted he found enjoyment in his botanical excursions and in the study of the local flora.

Seven years ago he lost the use of his limbs, and since that time he had been confined to the house a helpless invalid. All these years of affliction he found comfort in his family, a wife and four children, two sons and two daughters, and in his herbarium. He kept up his botanical correspondence and exchanges even to the last month of his life. On the evening of March 2d he fell asleep and a varied and useful life was closed.

He was the author of several pieces of musical composition, among which are "Minnie Moore," his favorite; "The old Arm Chair," "His pleasant Grave," "The dying Drummer Boy" and "The Wanderer's Dream," a piece which was played by the musicians of both armies during the Civil War. He was a correspondent of the Troy *Times* and at one time the editor of the *Family Journal*. In an article in the *Botanical Gazette*, February, 1881, he claimed the hybrid character of *Carex Sullivantii* Boott, which character is now generally admitted. In 1894, in connection with Dr. H. C. Gordinier, of Troy, he published the Flora of Rensselaer county, a Record of the Phenogams and Vascular Cryptogams growing in the county independent of cultivation. In it they record 1345 species and varieties. He wrote the descriptive article on the New York species of *Carex*, published in the 48th State Museum Report. In this he describes a new species, *Carex seorsa* Howe, and two new varieties, *C. lenticularis merens* Howe and *C. Emmonsii distincta* Howe. This article represents much patient and painstaking labor on the part of its author, who gives very full and detailed measurements of different parts of the plant in each species. It shows what can be done by a man of firm purpose and in love with his work, even when hampered by conditions that would generally be considered sufficient to incapacitate any one for all work. He was the author of several species of fungi, among which are *Tricholoma Peckii*, *Hygrophorus Peckianus*, *Puccinia curtipes*, *P. Peckianus*, *Microsphaera menispermi*, *M. platani* and *M. symphoricarpi*.

He was a correspondent of Professors Gray, Wood, Lesquereux, Dr. Vasey and many other prominent botanists of their day. He was also a correspondent of several European botanists of note. While at Fort Edward he directed the attention of the writer to the interesting features of mycology and induced him to enter this field of botanical investigation, which at that time was almost a *terra incognita* in this country. This was the beginning of a friendship that our botanical excursions, our correspondence, and personal intercourse have served to make stronger and stronger. He was diffident to a fault, strongly sympathetic with the suffering, generous and honorable in his dealings with all and preëminent in his profession for the correctness of his diagnoses of disease.

He has contributed many specimens to the state herbarium. These fine examples of flowering plants, mosses and fungi will continue silently, but effectively, to bear witness to his activity in collecting, his care and neatness in preparing, and his generosity in giving specimens of plants in the study of which he took so much pleasure. His name is fittingly commemorated by two fungi, *Stropharia Howeana* Pk. and *Hypoxylon Howeanum* Pk.

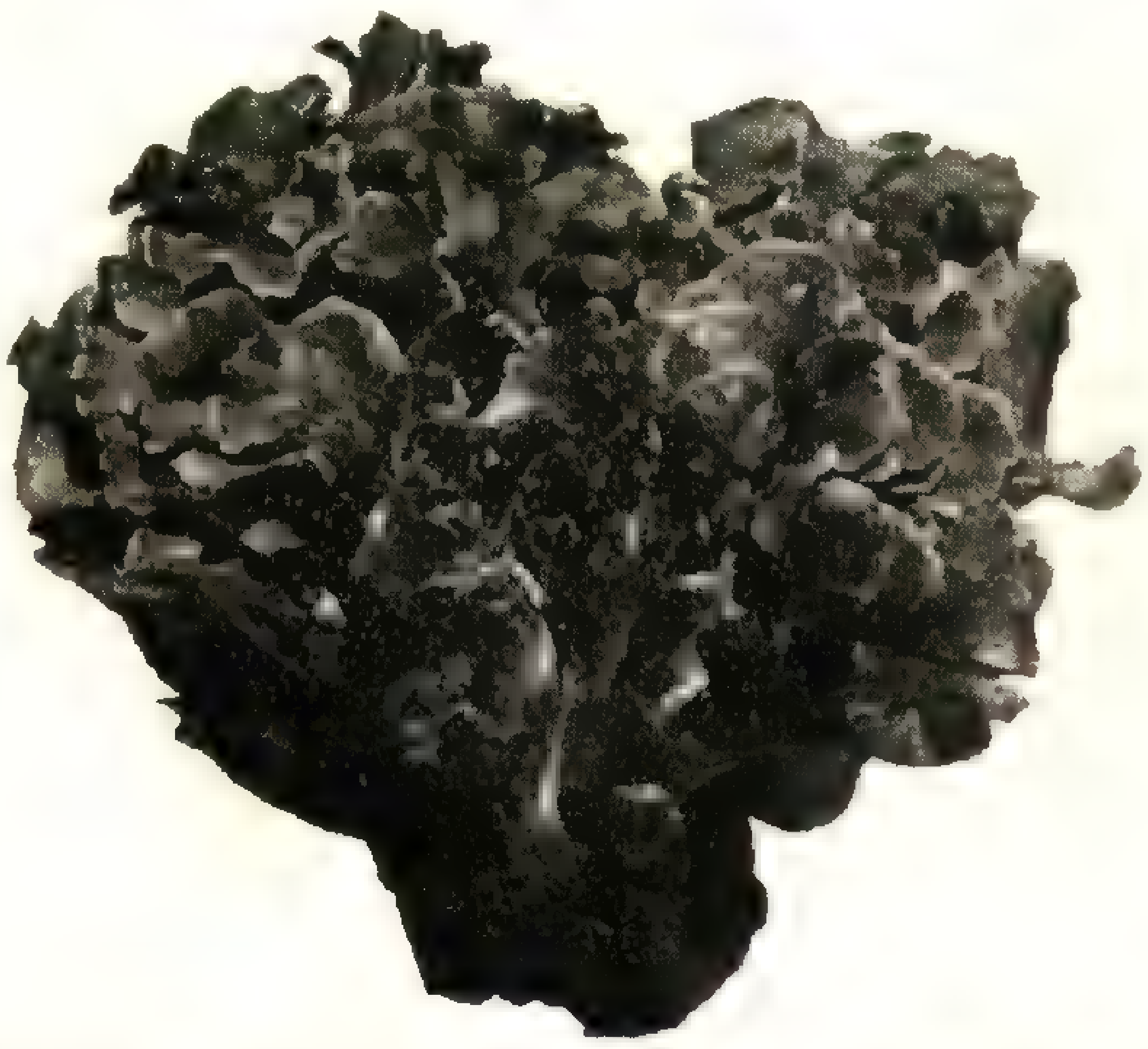
A new Cantharellus from Maine

By Lucien M. Underwood

Cantharellus multiplex

Cespitose-multiplex from a compact base which is nearly black when dry ; pilei more or less flabellate, compound, 3–5 cm. wide, nearly as long, blackish above in drying, cinereous beneath and concolorous to the base of the stipe where it joins the blackish base ; stipe 2–4 cm. long, often deeply grooved above by the decurrent margins of the pileus, occasionally somewhat tubular by their union along the outer edges ; hymenium radiately venulose-reticulate with irregular cross veinlets and frequent minute slit-like fissures and larger irregular depressions ; spores copious, 5–6 μ in diameter often appearing coarsely lobed when freshly moistened as though formed of united granules.

On the ground in dense woods of spruce and fir, Seal Harbor, Mt. Desert, Maine, August, 1898.



Cantharellus multiplex sp. nov., about one-fourth natural size.

The above description was taken from dried specimens which were sent me by Mrs. Elizabeth W. Woodworth, of White Plains, New York, who has also furnished the photograph from which the half-tone illustration was prepared. Mrs. Woodworth furnishes also the following data with reference to the plant in a fresh condition : "Growing in a large irregular mass and weighing from one to three pounds. * * * The color of the fresh pileus was dull purple or purplish lead color, the flesh was decidedly purple, tender and brittle ; spores white or whitish, very abundant, dusting the entire plant ; height six to twelve inches ; taste mild, odor aromatic. The plant suggested to me curly cabbage. * * * every curly edge having a silvery line, perhaps from the light colored spores ; * * * the leaf-like divisions are about a quarter of an inch in thickness, thinning out toward the edge. It breaks very easily when fresh. It is very rare in the Maine woods. I have found it for two years in the same place—two plants each year. * * * It grew on dry bare ground (possibly from decayed wood beneath) in dense second growth woods of spruce and fir."

The plant is a remarkable one and from its habit might well form a distinct genus since it has little in common with *Cantharellus* except its fold-like gills. It will perhaps be safer for the present to leave it in its present position.

New Plants from Colorado

By George E. Osterhout

Potentilla rupincola

Perennial from a branching caudex 2–3 dm. high, rather slender and paniculately branched, glabrous except for a few stiff, pointed hairs, and woolly pubescence at the base of the calyx and beneath it: the outer stems declined at base: numerous root leaves crowning the rootstock, 6–10 cm. long, slender-petioled, interruptedly pinnate with 5 to 7 leaflets which are narrowly cuneate, incised above with pointed teeth, glabrous except for a few stiff, pointed hairs on the midrib and margins: terminal leaflet petiolulate, the two adjacent lateral leaflets somewhat decurrent on the rachis: stem leaves reduced in size and number upward: stipules lanceolate: cyme diffusely and paniculately branched: the calyx about 5 mm. long, the lobes woolly at base and acuminate, the linear bractlets but little more than half their length: petals yellow, very broadly obovate and retuse, about the length of the calyx lobes: stamens about 18–20: pistils about 6: achene glabrous but imbedded in the wool of the receptacle, somewhat ovate, the upper end turned inward: the filiform style longer than the achene, attached to the under side of the incurved end.

This *Potentilla* belongs to the Leucophylla group as defined by Dr. Rydberg and is nearest to *P. effusa* Dougl. having much the same slender branching cyme and slender acuminate calyx lobes, but is readily distinguished from other members of the group by its glabrous character, and bright green crisp leaves. The specimens from which the description is drawn were collected at Dale Creek in Larimer Co., Colorado, July 20, 1898, where it grows in crevices of the high cliff on the east side of the creek and in seams of the outcropping rock on the west side. It was collected also in the cañon of the upper Cache La Poudre in August, 1893.

I wish to express my obligation to Dr. Rydberg's Monograph of the Potentilleae which makes a study of our *Potentillae* possible, and to Dr. Rydberg himself for the examination of specimens.

Astragalus Hypoglottis bracteatus

A slender usually branching perennial, from slender creeping rootstocks: stem about 2 dm. high, upright and slightly pubescent, a stout peduncle terminating the stem or branch and ending in an oblong head of white flowers: flowers upright, 2 cm. long, subtended by conspicuous, spatulate, green bracts: calyx pubescent with white hairs, 6–7 mm. long, the slender linear teeth of the same length: lower stipules small, sheathing the stem, the upper foliaceous and about 1 cm. long. The leaves and fruit are similar to the *Astragalus Hypoglottis* L. of our Manuals and Floras.

The variety is readily distinguished from the typical form by the white flowers and spatulate green bracts, even fruiting specimens being readily recognized by the latter. It is described from specimens collected in July, 1896, and again in 1898 along the Laramie river in Wyoming, about one half mile north of Colorado. It is referred to in Prof. Aven Nelson's First Report on the Flora of Wyoming under *Astragalus Hypoglottis* L. as "specimens with ochroleucous flowers" no. 775. Prof. Nelson has also collected it at other stations in Wyoming.

NEW WINDSOR, COLORADO.

Proceedings of the Club

JANUARY 10, 1899, ANNUAL MEETING

Vice-President Rusby presided; 15 present.

Nineteen new members were elected, as follows:

Mr. Wm. E. Dodge, 11 Cliff Street.
Mr. Walter S. Logan, 27 William Street.
Professor Henry F. Osborn, Am. Mus. Nat. Hist.
Mr. James B. Ford, 507 Fifth Avenue.
Leon Labonde, M.D., Ph.D., 174 Lincoln Ave., Newark, N. J.
Dr. Ludwig H. Reuter, Merck Building.
Very Rev. E. A. Hoffman, D.D., Chelsea Square.
Rev. Haslett McKim, 33 West 20th Street.
Mr. Samuel Sloan, 26 Exchange Place.
Mr. Frederick H. Comstock, 119 West 86th Street.
Mr. John T. Willets, 303 Pearl Street.
Mr. Samuel Thorne, 43 Cedar Street.
Miss Margaret F. Jaggers, 18 West 58th Street.

The above were nominated by Dr. Rusby, Chairman Committee on membership.

Also, Mrs. Horace See, 50 West 9th Street, by the secretary.

Ex-Chief Justice Charles P. Daly, 84 Clinton Place, by Dr. Britton.

Mr. Joseph Epes Brown, 123 Remsen St., Brooklyn, New York, by Dr. Rusby.

Mr. Joseph J. Arnaud, 409 East 78th St., by Frederick Ehrenberg.

Mr. John Trumbull Marshall, 205 West 106th St., Summer address Metuchen, New Jersey, by Dr. Underwood.

Professor Geo. Macloskie, Ph.D., University, Princeton, New Jersey, by Professor Lloyd.

One resignation was made and accepted, that of Mr. Benjamin Heritage, Michleton, N. J.

The second order of business was the presentation of annual reports of the officers and of the standing committees, in the following order:

Reports of the Treasurer, Recording Secretary, Corresponding Secretary, Editor, Curator and Librarian.

Reports of the Committees on Admissions, on Finance, on Herbarium, on Phanerogamic Local Flora, on Cryptogamic Local Flora, on Field Excursions, on Program and on Membership.

The Treasurer, Mr. Delafield, reported the Buchanan fund unchanged, and a balance of $44.48 on hand in the general fund.

The Recording Secretary, Professor Burgess, reported an average attendance of 39 at the 15 meetings held during the year, one death, a present active membership of 193, corresponding membership 140, honorary membership 3, total 336. The 27 scientific papers presented include 20 authors, among those nonresident being Dr. Radlkofer, of Munich, and Casimir De Candolle. About 30 new species have been described. Among the papers six related to cryptogams, two were on the nucleus, two were accompanied by lantern views and two by exhibitions of photographs; six were followed by symposia for which general discussions had been prepared. Special reports of collections and of botanical progress numbered 42. Two collations had marked the year's history, one tendered to the Club on March 8th, by the Teachers College, and one tendered by the Club to visiting botanists, especially to members of the Society of Plant Morphology, at Columbia University, December 29th.

The editor, Prof. Underwood, reported the regular monthly issue of the BULLETIN, including 640 pages and 29 plates, with a balance to the credit of the BULLETIN. Slight changes in the BULLETIN include the introduction of author and subject headlines, the arrangement of matter to begin each new article with a new page, and the use of improved plates. By discontinuing book reviews and miscellaneous notes, more space has been gained for articles. The number of pages is itself fifty in excess of those of the preceding year. New numbers of the Memoirs are in preparation. An endowment fund is greatly desired, by which secure provision may be made for prompt publication and superior illustration of American botanical researches.

The report of the Field Committee, through its Chairman, Mr. W. A. Bastedo, enumerated thirty-six field meetings, all held in coöperation with the Brooklyn Institute; three of these were three-day excursions in coöperation with the Philadelphia botanists, viz., Decoration Day to Point Pleasant, N. J., the Fourth of July to Stroudsburg, Pa., and Labor Day to Whitings, N. J.

In behalf of the Committee on Local Phanerogamic Flora, Dr. Britton referred to the work hitherto accomplished, as represented in Dr. Torrey's catalogue of 1819, and the two preliminary catalogues already published by this Club, by Mr. W. H. Leggett in 1875–6, and by Britton, Sterns and Poggenburg in 1888. Local catalogues within our range include those of Suffolk County, L. I., by Miller and Young, of Staten Island, by Dr. Hollick and others, of New Jersey by Dr. Britton, Dr. Rusby and others, of Long Island by Dr. Jelliffe. Special commendation should be given to Mr. Bicknell's work on the Westchester county flora. It was suggested that the new committee continue and combine the researches contributary to the ultimate publication of a comprehensive Flora of the Metropolitan District, adding such details as possible as to ecological features and quantitative characters of the floral covering.

In behalf of the Committee on Local Cryptogamic Flora, Mrs. E. G. Britton reported the continuance of work on mosses and other groups. A catalogue of the Mosses of the Botanical Garden at Bronx Park is about to be published in its annual report.

The third order of business was the annual election of officers, resulting in the reëlection of those of the previous year.

The fourth order of business was the presentation of miscellaneous notes and brief reports of scientific progress.

Dr. Britton read a letter which he had received that morning from Mr. A. A. Heller from Ponce, Porto Rico, announcing his arrival in health. He observed many interesting plants, as crotons, in the vicinity of Ponce. Mr. Henshaw is about to join him, for further collections, particularly of living material for the Botanical Garden.

Dr. Britton also reported the formal breaking of the ground on January 3d for the range of Horticultural houses for the Botanical Garden, which it is hoped may be ready for installation in October.

Dr. Rusby reported his possession of a Manuscript catalogue of the economic plants of Cuba and Porto Rico, giving the botanic names, uses, and common names, in about eight volumes of 200 pages each. This is the work of our corresponding member Professor De la Maza, of the University of Havana, who, although but a young man, has formed a large collection of plants there, comparing them carefully with the Charles Wright collection of Cuban plants, a set of which is in the University of Havana.

Recommendations made by the Editorial Board toward the securing of an endowment fund and an enlarged subscription list were approved and referred back to the editors with power.

WEDNESDAY EVENING, JAN. 25, 1899.

President Brown in the chair; present, 20.

The paper of the evening was by Dr. N. L. Britton, entitled, "Report on the progress of the N. Y. Botanical Garden; with photographs."

Dr. Britton said that during 1898 the species cultivated in the Garden at Bronx Park have reached 2110, a gain of 700 on the previous year. The fruticetum, on the plain northeast of the Museum building, was begun in October, and now includes 195 species. The arboretum has been increased to 178 species, including those native to the tract. A viticetum is in preparation, to be planted this spring, including rock-ledges and a rustic arbor about 600 feet long, now nearly completed. An additional nursery space near the southern corner of the tract was prepared last spring, and planted partly with Siberian cuttings. Border screens are now planted around the entire tract except to the south. A complete record of all plants grown is kept by means of a card catalogue. From every plant which flowers on the grounds an herbarium specimen is made; and these are classified in a special herbarium, useful already in satisfying inquiries. The use of the greenhouse on the Columbia University grounds at Morningside Heights was granted in 1896 and is still very important to the Garden. This is the old greenhouse built 1857 by Mr. S. Henshaw for the Bloomingdale Asylum, and is one of the oldest greenhouses still standing in the United States.

Progress on the Museum building has been active, and it is thought it will be ready to occupy by midsummer. The Power House is nearly ready to put into operation. A subway from this to the Museum is under construction. A stable, toolhouse, etc., have been built. The range of Horticultural Houses is planned to contain thirteen rooms; the contract for seven of these has been signed and ground was formally broken for them on January 3, 1899. Important work has been done toward improving the drainage of the Herbaceous Grounds, and considerable grading and the terraces about the Museum have been begun. The Lorillard Mansion is now used as a police station house, occupied by more than sixty-five officers, making a new and wholesome water supply necessary.

The Museum is planned to provide in the basement a lecture-room seating 900; on the first floor a collection of plant-products, with models and photographs: on the second, a scientific collection including a mounted collection of the local flora on swinging panels; followed by herbarium and laboratories on the top floor.

The herbarium already includes 30,000 specimens besides the Ellis collection. Through the liberality of Mr. Cornelius Vanderbilt, Mr. and Mrs. A. A. Heller are now making collections in Porto Rico. Messrs. P. A. Rydberg and Ernest Bessey made collections in 1897 in Montana, through the liberality of Mr. W. E. Dodge. The results will soon appear as a Flora of Montana, forming the first volume of the Memoirs of the New York Botanical Garden.

In discussion following it was stated that the deciduous trees planted are mainly on the east side of the Bronx River, about 5 of each species, allowing for survival of 2, 3 or 4, besides increased numbers of very rare trees and numerous trees planted for ornament. The stages of the bog-gardens will supply opportunity for comparative study of sub-aquatics by planting different examples of a species in varying conditions of moisture. The Bronx River has recently been occupying three different shallow channels, which would overflow when slightly obstructed. As a result, in April, 1898, there was four inches of water standing in certain low grounds of the north meadow for parts of two days. Since then the main channel has been deepened 18 inches, and the others closed by a stone dam. This may prevent a recurrence. In its 75 to 90 feet head of water-pressure, the Bronx Park Botanical Garden is very fortunate; that at Kew has to pump its water to a water-tower.

Adjournment followed.

TUESDAY EVENING, FEBRUARY 26, 1899

Dr. Rusby in the chair. 30 present.

Prof. F. E. Lloyd, secretary pro tem.

Prof. L. M. Underwood presented a paper on "Species confused under *Aspidium juglandifolium*," discussing the characters and geographical distribution of the forms regarded by him as distinct species, eight in all, constituting the whole number attributed to the genus *Phanerophlebia*. He remarked in concluding that it would be unsafe to describe new species without consulting the valuable collections of ferns in Europe, and especially at Kew. The paper appears in this number of the BULLETIN.

Miss Alice Lounsberry then exhibited the valuable collections of flower paintings by Mrs. Ellis Rowan, which constitute the originals of the colored plates in Miss Lounsberry's forthcoming work, "How to know the wild flowers." Selections which showed the character of the book were read, including the Introduction, written by Dr. Britton, and the Preface, which pointed out the fact that the distribution of plants according to soil was made the keynote of the work.

Dr. Britton said that the book was interesting to him on two accounts, from the ecological basis of classification and the remarkable reproduction in color.

In the absence of Mrs. Annie Morrill Smith, of Brooklyn, Mrs. E. G. Britton read for her the manuscript of a paper, entitled "The flora of the Adirondack Mountain Club area."

Dr. Britton submitted a report of the Committee on "Material for Nature Study in the Public Schools of New York City." The report was adopted without discussion, and is as follows:

"To The Torrey Botanical Club:

"Your Committee, appointed to draft a statement relative to material for Nature Study in the Public Schools of New York City, for transmittal to the President of the Board of Education after approval by the Club, would respectfully report the following preamble and resolutions:

"WHEREAS: The observation and study of natural objects is the primary source of all knowledge, tends to broaden the mind, to quicken the perception, to develop habits of serious thought, to give pleasure and to excite interest, "*Resolved:* That it is the opinion of this society that if the Public Schools of this City can be regularly supplied with specimens of living plants and animals, and with cabinets of minerals, rocks, shells and other natural objects judiciously selected, and the children be properly taught to observe and study them, a most important educational feature will be added to the present courses of instruction,

"*Resolved:* That the Honorable President of the Board of Education be and is hereby earnestly requested to take this suggestion into consideration for such action as he may deem desirable.

"Respectfully submitted,

"N. L. BRITTON,
"MARIE L. SANIAL,
"H. H. RUSBY,
"Committee."

Dr. Rusby read a letter from Miss Luella Agnes Owen, 306 North 9th Street, St. Joseph, Mo., expressing her interest in the Club, and enclosing a check for $10.00 to be added to its funds.

On motion of Dr. Britton, the sum ($10.00) was made a nucleus of a publication fund.

Dr. Britton stated that 3 boxes of plants had arrived from Mr. H. H. Smith, from the Santa Marta region, New Granada.

Twelve new members were elected, on the nomination of Dr. H. H. Rusby as Chairman of Membership Committee, viz.:

Paton, Wm. Agnew, room 32, 7 Nassau Street.
Pryor, Charles, New Rochelle, N. Y.
Sackett, Henry W., Tribune Building.
Blodgett, Mrs. Wm. T., 24 West 12th Street.
Fellowes, Frank Wayland, New Haven, Ct.
Marc, Theophilus H., 359 Produce Exchange.
Emerson, Miss Julia T., 81 Madison Ave.
Watson, Rev. J. Henry, 355 West 20th Street.
Chamberlain, Rev. L. T., 222 West 23d Street.
Hinton, M. H., M.D., 41 West 32d Street.
Sturgis, Miss F. K., 3 West 36th Street.
Volney, C. W., 173 West 81st Street.

TUESDAY EVENING, MARCH 14, 1899

President Brown in the chair; 27 were present.

Five resignations were read and accepted.

The Secretary laid before the Society the announcement of the annual grant for the encouragement of research given from the Newberry fund, and open this year to work in botany or in zoölogy.

The paper of the evening by Mrs. Caroline A. Creevy, on "Plant Juices and their Commercial Values," described the secretions, oils, gums, resins and other products of plants, with exhibition of numerous specimens. Juices of value are most largely developed in the tropics. The history and present condition of the India-rubber industry was discussed, and that of gutta percha.

Dr. Underwood exhibited a series of photographs of the Fleshy Fungi by Mr. J. A. Anderson, of Lambertville, N. J., colored from the living specimens by his daughter, Miss H. C. Anderson. They illustrate a new process for preserving illustrations of fleshy fungi.

Dr. Britton reported a brief communication from Mr. A. A. Heller, sent from Porto Rico, February 18th, reporting collections made about Ponce, Ibonito, Coamo, etc., now reaching 564 numbers after six weeks' work. On the north side of the island many species occur on the shore which are montane species when growing on the south side.

Dr. Britton also read from a letter of February 26th, just received from Mr. S. Henshaw, from San Juan, describing the sugar plantations, now in the midst of cutting and boiling. He finds the flora not so varied as in Trinidad; the woods are few; in 100 miles he did not see a single large tree.

EDWARD S. BURGESS,
Secretary.

Index of Recent Literature Relating to American Botany

Bastedo, W. A. The Botany of Sassafras. Pharm. Era: 741–743. 1 D. 1898.

Bourquelot, E. & Herissey, H. Sur la présence d'un ferment soluble protéo-hydrolytique dans les Champignons. Bull. Soc. Mycol. de France, **15**: 60–67. 31 Ja. 1899.

Britton, E. G. A new Tertiary Fossil Moss. Bull. Torr. Bot. Club, **26**: 79–81. 18 F. 1899.

Britten, J. Notes on *Saxifraga*. Jour. Bot. **37**: 66–70. F. 1899.

Burgerstein, A. Beiträge zur Xylotomie der Pruneen. Verhandl. k. k. zool.-bot. Gesellsch. Wien, **49**: 28–32. 27 F. 1899.

Cheney, L. S. Notes on the Flora of Wisconsin. Pharm. Archives, **2**: 41–49. Mr. 1899.

Clute, W. N. The Making of an Herbarium. First paper—Collecting. Plant World, **2**: 92–95. *f. 1–2.* Mr. 1899.

Cowan, F. H. *Rhododendron maximum* in Somerset County, Maine. Rhodora, **1**: 55. Mr. 1899.

Coville, F. V. Bemerkungen zu Aufsatze von F. Buchenau über einige Nomenclaturfragen. Engler Bot. Jahrb. **26**: Beibl. no. 61. 1–2. 24 Ja. 1899.

Collins, J. F. Rhode Island Plant-Notes. I. Wastes. Rhodora, **1**: 46–48. Mr. 1899.

Cogniaux, A. Une Orchidée nouvelle du Brésil. Bull. Herb. Boiss. **7**: 120. 16 F. 1899.

Bulbophyllum cryptanthum Cogn sp. nov.

Deane, W. The Herbarium of the New England Botanical Club. Rhodora, **1**: 56, 57. Mr. 1899.

Duggar, B. M. Peach Leaf-curl and Notes on the Shot-hole effects of Peaches and Plums. Bull. Cornell Univ. Agric. Exp. Sta. 164: 369–388. *f. 64–72.* F. 1899.

Duggar, B. M. On the Development of the Pollen Grain and the Embryo-sac in *Bignonia venusta*. Bull. Torr. Bot. Club, **26**: 89–105. *pl. 352–354.* 18 Mr. 1899.

Duggar, B. M. The shot-hole Effect on the Foliage of the genus *Prunus*. Proc. Soc. Promotion Agric. Sci. **19**:—(1–7). 1899.

Duggar, B. M. Three important Diseases of the Sugar Beet. Bull. Cornell Univ. Agric. Exp. Sta. 163: 337–363. *f. 49–63.* F. 1899.

Earle, F. S. Cotton Rust. Bull. Ala. Exper. Sta. 99: 281–309. D. 1898.

Finet, A. Notes sur les Orchidées. Bull. Herb. Boiss. **7**: 121–123. *pl. 3.* 16 F. 1899.

Hormidium pseudo-pygmaeum sp. nov., and notes from Costa Rica on a cleistogamous form of *Epidendrum bicornutum* Hooker.

Evans, A. W. List of Hepaticae collected along the International Boundary by J. M. Holzinger, 1897. Minn. Bot. Studies, **2**: 193. 22 F. 1899.

Farlow, W. G. Poisoning by *Agaricus illudens.* Rhodora, **1**: 43–45. Mr. 1899.

Fernald, M. L. Two plants of the Crowfoot Family. Rhodora, **1**: 48–52. *pl. 3.* Mr. 1899.

Anemone riparia sp. nov. and *Ranunculus abortivus eucyclus* var. nov.

Freeman, E. M. Observations on *Constantinea.* Minn. Bot. Studies, **2**: 175–190. *pl. 17, 18.* 22 F. 1899.

Fink, B. Contribution to the Life-history of *Rumex.* Minn. Bot. Studies, **2**: 137–153. *pl. 9–12.* 22 F. 1899.

Graebner, P. Beiträge zur Kenntniss der Sud- und Centralamerikanischen Valerianaceae. Engler, Bot. Jahrb. **26**: 423–436. 31 Ja. 1899.

New species are described in *Valeriana.*

Grout, A. J. An annotated List of rare or otherwise interesting Mosses occurring in or near Plymouth, New Hampshire. Rhodora, **1**: 53–55. Mr. 1899.

Grout, A. J. Supplement to the List of the Mosses growing in the State of Vermont. 41–44. Ja. 1899.

Greene, E. L. Early specific types in *Chamaecrista.* Pittonia, **4**: 25–32. 17 Mr. 1899.

Greene, E. L. New Species of *Sisyrinchium.* Pittonia, **4**: 32–34 17 Mr. 1899.

S. Langloisii, *S. xerophyllum*, *S. littorale*, *S. montanum* and *S. halophilum*, new species.

Greene, E. L. New or Noteworthy Species.—XXIV. Pittonia, **4**: 35–40. 17 Mr. 1899.

New species in *Ribes*, *Arnica*, *Agoseris*, *Lactuca*, *Campanula*, *Pyrola*, *Phacelia*, and *Antennaria.*

Greene, E. L. New Species of *Castelleia.* Pittonia, **4**: 1, 2. 5 Ja. 1899.

C. confusa, C. remota, C. subinclusa and *C. Haydeni* sp. nov. the latter raised from *C. pallida* var. *Haydeni* Gray.

Greene, E. L. A Fascicle of new Violets. Pittonia, **4**: 3–9. 5 Ja. 1899.

V. falcata, V. conjugens, V. subsinuata, V. Mistassinica, V. Watsoni, V. retusa and *V. cyclophylla*, sp. nov. *V. alsophila* substituted for *V. amoena* Le C., *V. sempervirens* for *V. sarmentosa* Dougl., *V. Rafinesquii* for *V. bicolor* Pursh, and *V. vicinalis* for *V. insignis* Pollard.

Gueguen, F. Recherches sur les organismes myceliens des solutions pharmaceutiques. Bull. Soc. Mycol. de France, **15**: 15–36. *pl. 1.* 31 Ja. 1899.

Cytological and antiseptic studies of *Penicillium.*

Griffiths, D. Some Northwestern Erysiphaceae. Bull. Torr. Bot. Club, **26**: 138–144. 18 Mr. 1899.

Howe, C. D. A preliminary List of the Hepaticae of Vermont. Contrib. Bot. Vt. **3**: 1–10. Ja. 1899.

Hansen, G. The Lilies of the Sierra Nevada. Erythea, **7**: 21–23. 1 Mr. 1899.

Hansen, G. Calochorti in the Sierra Nevada. Erythea, **7**: 13–15. 6 F. 1899.

Huber, J. *Dipterosiphon spelaeicola* nov. gen. et spec. eine höhlenbewohnende Burmanniacee aus brasilianisch Guyana. Buil. Herb. Boiss. **7**: 124–128. *pl. 4.* 16 F. 1899.

Halsted, B. D. Mycological Notes .IV Bull. Torr. Bot. Club, **26**: 12–20. 16 Ja. 1899. [Illust.]; V—**26**: 72–78. 18 F. 1899.

Hope, C. W. Note on *Asplenium Glenniei* Baker in Synopsis Filicum, 2d ed. p. 488. Bull. Torr. Bot. Club, **26**: 58–62. 18 F. 1899.

Hooker, J. D. *Gynopleura humilis.* Curt. Bot. Mag. **55**: *pl. 7645.* Mr. 1899.

Native of Chili.

Hooker, J. D. *Passiflora prunosa.* Curt. Bot. Mag. **55**: *pl. 7643.* Mr. 1899.

Native of British Guiana.

Hooker, J. D. *Epilobium obcordatum.* Curt. Bot. Mag. **55**: *pl. 7641.* F. 1899.

Native of California.

Hooker, J. D. *Ceanothus integerrimus.* Curt. Bot. Mag. **55**: *pl. 7640.* F. 1899.
Native of California.

Harper, R. M. Additions to the Flora of Worcester County, Massachusetts I. Rhodora, **1**: 42, 43. Mr. 1899.

Harshberger, J. W. The Names of the Big Tree of California. Forest Leaves, **7**: 25, 26. Ap. 1899.

Halsted, B. D. Report of the Botanical Department of the New Jersey Agricultural College Experiment Station for the year 1898. Rep. N. J. Agric. Exper. Sta. 289–370. 1899.

Halsted, B. D. The poisonous Plants of New Jersey. Bull. N. J. Agric. Exper. Sta. **135**: 1–28. *f. 1–10.* 8 F. 1899.

Hitchcock, A. S. Studies on Subterranean Organs. I. Compositae of the Vicinity of Manhattan, Kansas. Trans. Acad. Sci. St. Louis, **9**: 1–8. *pl. 1.* 18 F. 1899.

Hoffman, R. *Epipactis Helleborine* at Stockbridge, Massachusetts. Rhodora, **1**: 52, 53. Mr. 1899.

Holm, T. Studies in the Cyperaceae. VIII. On the Anatomy of some North American Species of *Scleria*; IX. The Genus *Lipocarpha* R. Br. Am. Jour. Sci. **7**: 5–12. *f. 1–6.* Ja. 1899; 171–183. *f. 1–9.* Mr. 1899.

Hough, W. Tuna and its Uses. Plant World, **2**: 98–100. Mr. 1899.

Hunnewell, J. M. *Chrysanthemum segetum* L. at Marion, Massachusetts. Rhodora, **1**: 57. Mr. 1899.

Jackson, B. D. A Review of the Latin Terms in Botany to denote Color. Jour. Bot. **37**: 97–106. Mr. 1899.

Klebahn, H. Ein Beitrag zur Getreiderostfrage. Zeitschr. für Pflanzenkr. **8**: 321–342. *pl. 6.* 4 F. 1899.

Kozlowski, W. M. The primary Synthesis of Proteids in Plants. Bull. Torr. Bot. Club, **26**: 35–57. 18 F. 1899.

Knowlton, F. H. Fossil Wood and how it is studied. Plant World, **2**: 95–98. *pl. 6.* Mr. 1899.

Lloyd, C. G. Mycological Notes. 9–16. F. 1899.
Notes on *Volvaria* with *V. umbonata*, sp. nov, *Calvatia aurea* and the genus *Pluteus*.

MacDougal, D. T. Seed Dissemination and Distribution of *Razoumofskya robusta* (Engelm.) Kuntze. Minn. Bot. Studies, **2**: 169–173. *pl. 15–16.* 22 F. 1899.

Masters, M. T. The Bermuda Juniper and its Allies. Jour. Bot. **37**: 1–11. Ja. 1899.

Mohr, C. Notes on some new and little known Plants of the Alabama Flora. Bull. Torr. Bot. Club, **26**: 118–121. 18 Mr. 1899.
Prunus Alabamensis, *Physalis monticola* and *Solidago pallescens*, sp. nov.

Moyer, L. R. Extension of Plant Ranges in the upper Minnesota Valley. Minn. Bot. Studies, **2**: 191–192. 22 F. 1899.

Ness, H. A new Species of *Lacinaria*. Bull. Torr. Bot. Club, **26**: 21–22. *pl. 351.* 16 Ja. 1899.
Lacinaria cymosa Ness.

Niedenzu, F. De genere *Malpighia*. (Dissertation.) 4to. 1–22. Brunsbergae 1899.
M. nummulariafolia sp. nov. from Cuba.

Olsen, M. E. Observations on *Gigartina*. Minn. Bot. Studies, **2**: 154–168. *pl. 13, 14.* 22 F. 1899.

Pammel, L. H. The Histology of the Caryopsis and Endosperm of some Grasses. Trans. Acad. Sci. St. Louis, **8**: 199–220. *pl. 17–19.* 29 D. 1898.

Peck, C. H. New Species of Fungi. Bull. Torr. Bot. Club, **26**: 63–71. 18 F. 1899.
New species in *Lepiota*, *Tricholoma*, *Hygrophorus*, *Volvaria*, *Clitopilus*, *Leptonia*, *Flammula*, *Galera*, *Crepidotus*, *Agaricus*, *Psathyra*, *Coprinus*, *Polyporus*, *Craterellus*, *Fistulina*, *Helvella*, and *Microglossum*.

Ramaley, F. Seedlings of certain woody Plants. Minn. Bot. Studies, **2**: 69–86. *pl. 1–4.* 22 F. 1899.

Ramaley, F. Comparative Anatomy of Hypocotyl and Epicotyl in woody Plants. Minn. Bot. Studies, **2**: 87–136. *pl. 5–8. f. 1–23.* 22 F. 1899.

Rashleigh, J. *Pinus Montezumae.* Gardn. Chron. **25**: 146. *f. 53.* 11 Mr. 1899.

Rendle, A. B. Steudel's "Synopsis Plantarum Glumacearum." Jour. Bot. **37**: 33, 34. Ja. 1899.

Rothrock, J. T. Big White Oaks. Forest Leaves, **7**: 24. *pl.* Ap. 1899.

Rothrock, J. T. A Pennsylvania *Sequoia*. Forest Leaves, **7**: 24. *pl.* Ap. 1899.

von Rother. Ueber die Nomenclature der Phyllocacteen. Monatsschr. für Kakteenkunde, **9**: 25. 15 F. 1899.

Rydberg, P. A. A Monograph of the North American Potentilleae. Mem. Dept. Bot. Columbia Univ. **2**: 1–221. *pl. 1–112.* 25 N. 1898.

Three new genera are proposed: *Stellariopsis* (*Potentilla* § Stellariopsis, Baillon), founded on *Ivesia santalinoides* Gray, *Comarella* founded on *Horkelia ? multifoliata* Torr. and *Potentilla sabulosa* Jones; and *Sibbaldiopsis*, founded on *Potentilla tridentata* Soland. Many new species, varieties, and names in *Potentilla*, *Horkelia*, *Argentina*, *Fragaria*, *Dasiphora* and *Drymocallis.*

Saunders, DeA. Four siphoneous Algae of the Pacific Coast. Bull. Torr. Bot. Club, **26**: 1–4. *pl. 350.* 16 Ja. 1899.

Schmidle, W. Algologische Notizen. All. Bot. Zeitsch. **5**: 2. Ja. 1899.

Description of a new genus and species, *Phylloplax candelabrum* from Ecuador.

Scribner, F. L. & Williams, T. A. New Species of North American Grasses. Circ. U. S. Dept. Agric. (Div. Agrost.) 9: 1–7. 24 F. 1899.

New species in *Poa*, *Eragrostis* and *Elymus.*

Schumann, K. Die Frucht von *Cereus hamatus* Scheidw. Monatsschr. für Kakteenkunde, **9**: 22–25. *pl.* 15 F. 1899.

Schumann, K. *Echinocereus inermis* Fr. Ad. Hge. oder *Echinocereus Knippelianus* Liebn. Monatsschr. für Kakteenkunde, **9**: 25–27. 15 F. 1899.

Setchell, W. A. Directions for collecting and preserving Marine Algae. Erythea, **7**: 24–34. 1 Mr. 1899.

Smith, E. F. The Second Annual Meeting of the Society for Plant Morphology and Physiology. Am. Nat. **33**: 199–217. Mr. 1899.

Stone, G. E., & Smith, R. E. Nematode Worms. Bull. Mass. Exper. Sta. 55: 1–68, *pl. 1–12.* N. 1898.

Prepared by botanists and contains much that is botanical.

Sturgis, W. C. Report of Mycologist. Rept. Conn. Exper. Sta. **21**: 159–222. 1898.

Gives literature of fungous diseases.

Toy, C. H. Etymology of *Anemone.* Rhodora, **1**: 41, 42. Mr. 1899.

True, R. H. The physiological Action of certain plasmolyzing Agents. Bot. Gaz. **26**: 407–416. D. 1898.

Vail, A. M. Studies in the Leguminosae.—III. Bull. Torr. Bot. Club, **26**: 106–117. 18 Mr. 1899.

Notes on the genus *Dolicholus* (*Rhynchosia*) in the United States, with new names, species, and varieties, and note on *Parosela Lumholtzii* (Rob. & Fern.).

Van Tieghem, P. Avicenniacées et Symphoremacées. Place de ces deux nouvelles Familles dans la classification. Jour. de Bot. **12**: 345–352. 16 N. 1898; 353–365. 1 D. 1898.

Waugh, F. A. The early botanical Views of *Prunus domestica*. Bot. Gaz. **26**: 417–427. D. 1898.

Webster, H. Notes on *Calostoma*. Rhodora, **1**: 30–33. F. 1899.

Webster, H. Notes on some fleshy Fungi found near Boston. Rhodora, **1**: 13–18. Ja. 1899.

Webster, H. Fungus Notes. Rhodora, **1**: 57–58. Mr. 1899.

Wiegand, K. M. Some new Species from Washington. Bull. Torr. Bot. Club, **26**: 135–137. *pl. 355*. 18 Mr. 1899.

Allium crenulatum, *Lathyrus Torreyi tenellus*, *Hydrophyllum congestum*, and *Senecio Flettii*.

Williams, E. F. The New England Botanical Club. Rhodora, **1**: 37–39. F. 1899.

Zeiller, R. Revue des Travaux de Paleontologie végétale, publies dans le cours des années, 1893–1896. Rev. Gen. de Bot. **9**: 324–336. 1897; 360–384. 1897; 399–416. *pl. 20–21*. 1897; 449–462. 1897; 26–32. 15 Ja. 1898; 69–80. 15 F. 1898.

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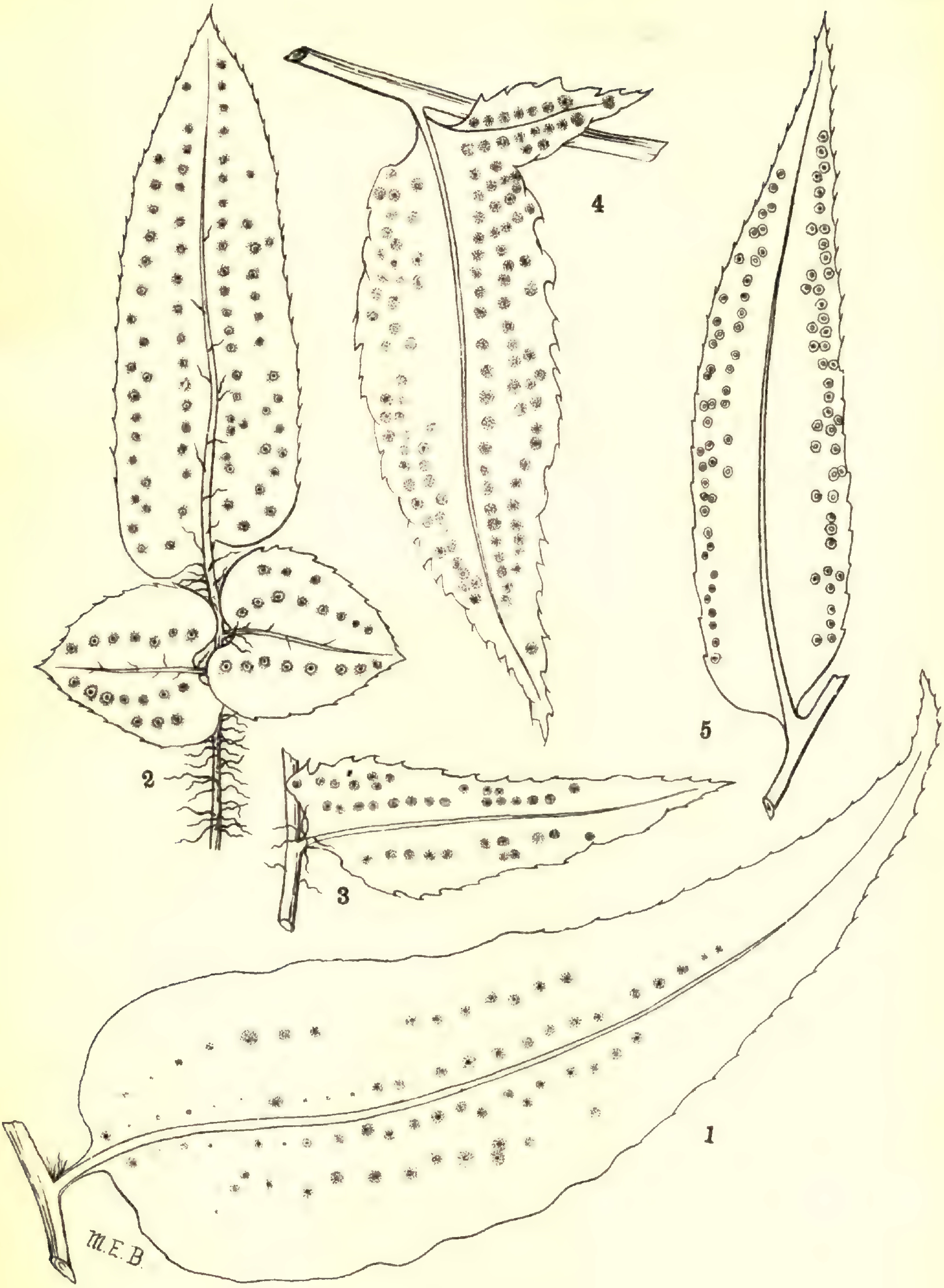

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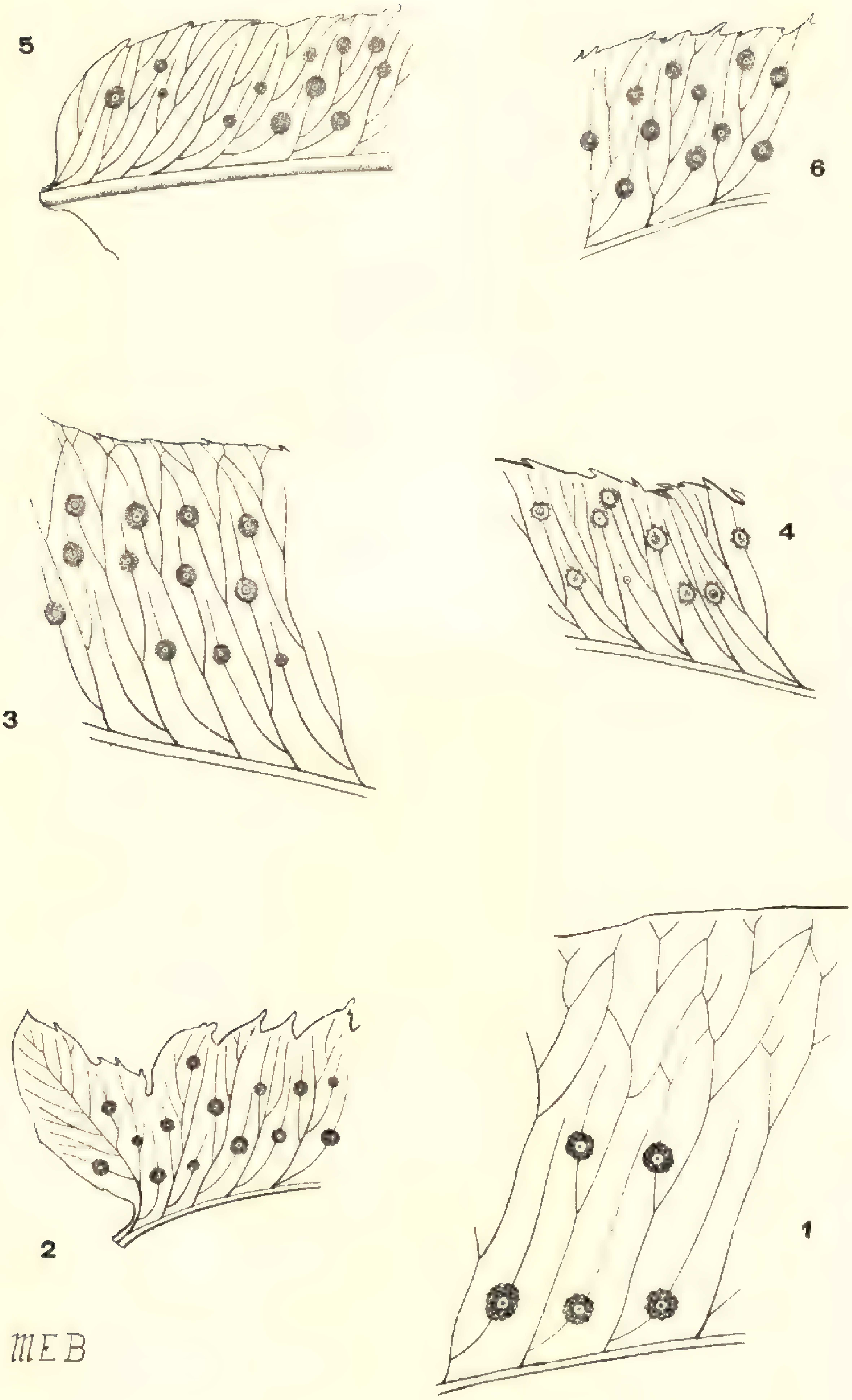

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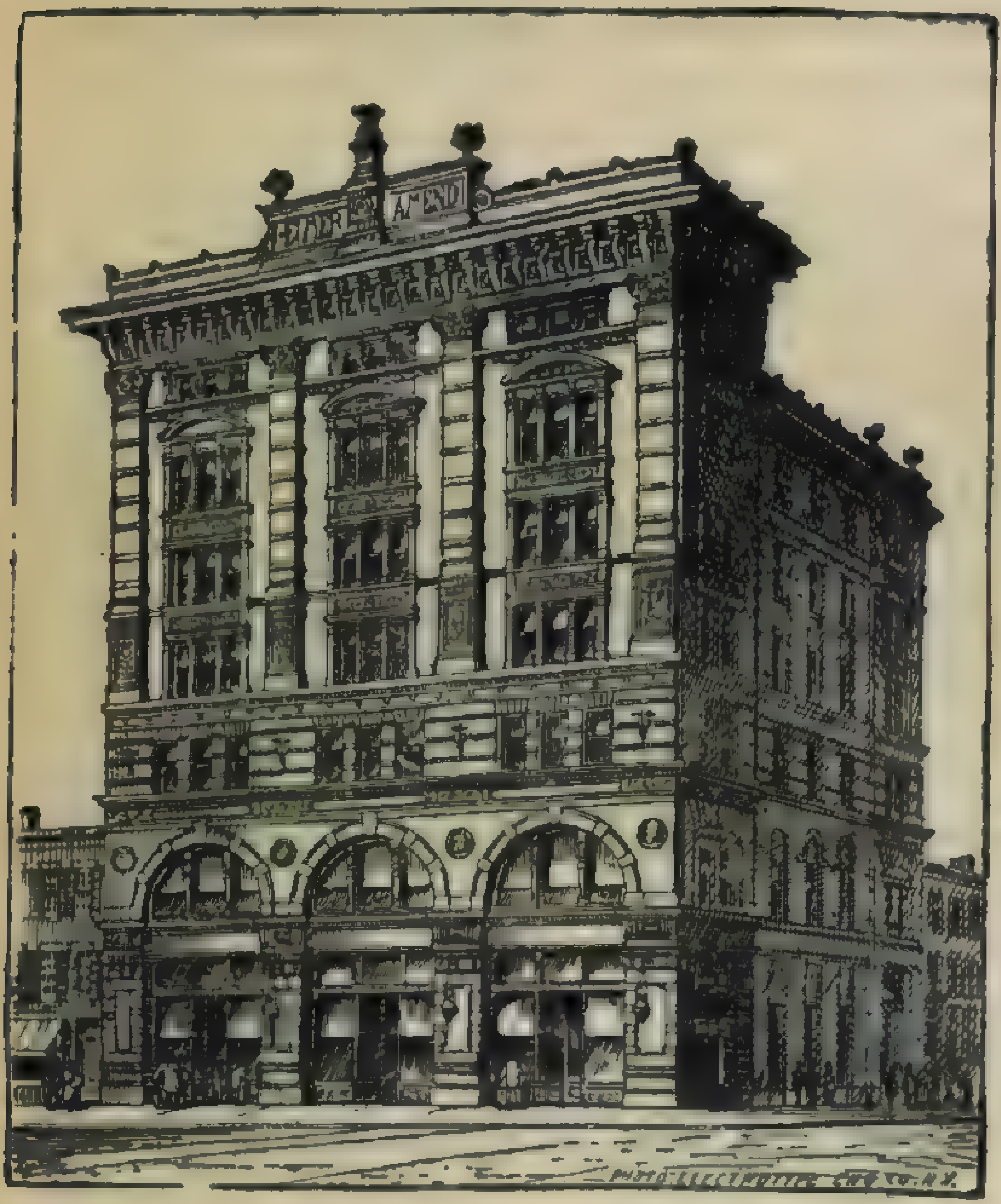

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OF THE
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JUNE 1899

Observations on Nereocystis

BY CONWAY MACMILLAN

(WITH PLATES 361, 362)

Introductory and Historical.—The bladder-kelp of the northern Pacific coast, first described by Mertens in 1829 under the name of *Fucus Lütkeanus* and afterwards made the type of the genus *Nereocystis* by Postels and Ruprecht, has never received the study that its great size and abundance would have led one to expect. A brief and incomplete account of its anatomy is given by Postels and Ruprecht in their *Illustrationes Algarum*, in which Plate XXXIX., Figs. 24–30 are of the histology of the mature stipe, pneumatocyst and lamina. The most extended anatomical study is that by Oliver in his paper on the *Obliteration of the sieve-tubes in Laminariaceae*, published eleven years ago in the *Annals of Botany*, while some isolated references may be found scattered through the literature of the Laminariaceae and that of West American algae.

I have had the unusual opportunity of examining some hundreds of specimens of *Nereocystis Lütkeana* collected at Puget Sound during 1897 and 1898 by Miss Josephine E. Tilden. The series includes undoubted specimens from one-half of a millimeter in length to eighty feet and serves to illustrate many points of the anatomy and development which have not hitherto been described. Still younger forms carrying the series back close to the germinating spore are probably in the collection but I am not yet prepared

[Issued June 17]

to speak with absolute certainty of any plant under one-half millimeter in length. The reason for this is that the youngest plants, collected in two feet of water off San Juan Island at 10 A. M., June 5, 1898, during the lowest low tide of the year, are mingled with young *Costaria Mertensii*, *Laminaria saccharina* and *Alaria*. It is difficult to distinguish the young stages of Laminariaceae from each other and this difficulty increases inversely with the age of specimens. Yet a careful comparison of sections shows structural peculiarities which enable one to speak with some degree of certainty.

The first published reference to young *Nereocystis* plants and the first descriptions of their fruiting structures are those of Areschoug in a paper in the Swedish journal, Bot. Notiser of 1876, pp. 65–73 and in Observationes Phycologicae. In the first paper Areschoug describes his *Pelagophycus giganteus* under the name of *Nereocystis gigantea*. In this article he describes the young unilaminate plant and explains how the lamina is split vertically and how each half is repeatedly split. He describes the change in shape of the pneumatocyst as it develops and makes some anatomical observations upon the mucilage ducts which are quoted later by Guignard. The resemblance of the young *Nereocystis* plant to young *Laminariae* was apparent to him.

The only previous American reference that I have found to young *Nereocystis* plants—in which, I have been unable to discover any addition to the facts set down by Areschoug thirteen years before—is in one of the more recent papers of Professor W. G. Farlow of Harvard University who, in the Bulletin of the Torrey Botanical Club for 1889, comments upon a series of young plants presented to him by Miss Lennebacker, concerning which, however, I have not learned that he ever published further. The smallest plant he mentions was four inches in length and he states that the "bladders begin to show themselves when the plants are about eight inches long." It is possible, however, by the sense of touch to distinguish the pneumatocyst in material but three centimeters in length and the organ becomes visible as a slight expansion of the stipe shortly after. Professor Farlow, with Areschoug, observed the resemblance of the immature plants to young Laminariaceae of the digitate section, possibly basing his statement upon Foslie's plates. It is certainly striking and even more so when still younger material is compared. I do not know what precautions Miss Lennebacker took in the selection of her series, but from Professor Farlow's observation that the stipe is slender and *short* I should think that possibly some *Laminaria* sporelings might have been included. My own researches have shown that in *Nereocystis* plants only one millimeter in length the stipe is nearly as long as the lamina while in plants three centimeters long the stipe is five millimeters in length, showing an early, rapid elongation of the lamina.

General Structure.—The general organography of *Nereocystis* may be best explained by describing the plant as made up of two principal areas—a proximal, affixed portion and a distal free portion. At first when the plants are merely elongated pear-shaped bodies less than .1 mm. in length (as probable from the examination of material that I am yet compelled to consider doubtful) the holdfast or proximal portion is spread out as a disc-shaped foot from the under side of which numerous rhizoid-protuberances are affixed to the substratum, while the distal portion enlarging apically is still of a generally cylindrical shape. This primitive holdfast or "primitive disc" recalls the similar structure described for young specimens of *Saccorhiza dermatodea* by Professor Setchell and for *Laminaria* by Foslie. As in *Saccorhiza* the primitive disc is provided with a crenate margin which becomes lobed and the lobes develop into protuberances which may be termed the primitive hapteres. Later when the plant is a centimeter or more in height, but sometimes not until four or five times as long, the secondary hapteres begin to show themselves as rows of emergences just above the point where the primitive disc passes over into the distal portion of the plant. These secondary marginal hapteres flatten themselves where they come in contact with the substratum and the whole primitive disc develops into a sucker-shaped cup. Above the first secondary hapteres others commonly develop, the number of emergences in the broken whorls being somewhat variable, but in general each emergence stands over an emergence of the whorl below. In this way, finally, a large hapteric area, the "holdfast," is developed consisting of hundreds of dichotomously branched cylinders and forming a ramose body more than a foot in diameter.

The primitive disc finally stands near the center of the great fixation-organ made up of the hapteres progressively developed from above. If growing upon a flat surface, the ends of the hapteres originating from higher whorls on the stipe stand concentrically outside of those belonging to hapteres of lower whorls and the whole apparatus is to be diagrammed as a series of superposed cones very much flattened and split.

In old material of *Nereocystis* a great many confluent callosities may occur along the stipe. These originate from emergences precisely similar to those which produce hapteric branches and probably the callosities may be regarded as homologous with unattached hapteres. I have not observed dichotomy in any of the callosities nor need I discuss at length their probable function. It suffices to indicate their great similarity of origin to the secondary hapteres, suggesting that the whole stipe is capable of forming holdfast organs from the base to the pneumatocyst. The callosities are sometimes as large as one's finger and spirally disposed around the slender stipe reminding one a very little of a loose growth of *Cuscuta* on the stem of a flowering plant. This position I regard as indicating torsions of growth in the stipe and it has been clearly observed that while the elongated callosities are in some cases confluences, in others they originate from single original hemispherical protuberances. On the stems of young plants a foot or two in length the callosities are extremely rare, but they progressively develop and increase in number and size until old stems are abundantly provided with them along much of their extent. They are particularly in evidence when two or more plants growing close together have twined about each other as they often do. On the stipes of such the callosities are developed as a continuous cushion where the stems are in contact. Although really organs of the stipe, I have mentioned these callosities at this point because of their evident homology with the hapteres.

The distal end of the *Nereocystis* plant finally differentiates itself into three areas, stipe, pneumatocyst and lamina. When very young no distinction between these areas is visible, but in the smallest plants I have seen—and they may possibly be *Costaria*, *Laminaria* or *Alaria* sporelings rather than those of *Nereocystis*—the stipe is marked off by a sharp constriction from the primitive disc and gradually enlarges distally into a portion which afterwards undergoes a lateral flattening into lamina. The pneumatocyst originates as a swelling in the stipe just below the lamina and is the last of the three distal members to come into existence as such. At first the lamina is single and uncleft, of a rather narrow, lanceolate shape and becoming narrowly ovate with acute tip as it grows older. The first longitudinal slit which separates the lamina into two halves right and left appears near the base of the lamina (according to my series of young forms) when the length of the whole plant has reached about 13 cm. This cleft is the only one which reaches clear to the surface of the pneumatocyst though the second cleft comes very close and divides the two laminae into four. Oliver's statement, no doubt based upon an incorrect figure of Postels and Ruprecht, that as a rule five petioles are borne upon the pneumatocyst is quite unconfirmed by any of the plants which I have examined. On the contrary as pointed out by Areschoug there are but two main distinct laminae each of which is cleft almost to the base by the secondary longitudinal furrows and tertiary and successive furrows cleave these laminae almost to the base, so that a hasty examination suggests the presence of two tufts of leaves. In each tuft there may be twenty-five or more lobes or leaves. The resemblance of the leaf arrangement to that in Areschoug's *Pelagophycus giganteus*, a plant of the Californian coast and by some American students still maintained to be congeneric with *Nereocystis Lütkeana*, is certainly very demonstrable.

The origin of the clefts and of the pneumatocyst is better discussed in the histological portion of my paper but the primitive differentiation of lamina and stipe, since it arises simply by the lateral flattening of a primitive piriform distal bulb, may be noted here. At first the lamina is shorter than the stipe but after the plant has become about a tenth of a millimeter in length the lamina begins to elongate relatively faster for a time, but when the plant has reached a length of twelve or thirteen centimeters the elongation of the stipe becomes relatively more rapid and this ratio continues so that in a plant eighty feet long the stipe measures forty feet, from hapteres to pneumatocyst, and another forty to the tips of the slender ribbon-shaped lobes of the two great leaves. But in longer plants the stipe is proportionately more extended while the leaves rarely come to exceed fifty feet in length. This measurement of the leaves much exceeds that given by Mertens in his letter to his father published by von Chamisso in the 1829 volume of Linnaea. Mertens gives twenty-seven feet as the extreme leaf-length and Oliver, quoting no doubt from this original account by the discoverer places the leaf-length at eight meters. We have, however, leaves nearer fifteen meters in length than eight. A hundred meters as the extreme length of a mature individual, the figures given by Kjellman in the Engler-Prantl Natürpflanzenfamilien, is not at all excessive. Of this at least eighty meters would belong to the stipe, two or three meters to the elongated retort-shaped pneumatocyst and the remainder to the laminae.

The breadth of mature lobes of the lamina is from 8 to 12 cm., the diameter of the stipe is from 8 mm. to 2 cm. just under the pneumatocyst area, the pneumatocyst is sometimes 15 centimeters in diameter just below the attachment of the lamina and the branches of the haptere-cluster range from 3–5 millimeters in diameter. These measurements are all conservative and larger individuals may no doubt be found.

When first formed the pneumatocyst is spherical and retains this shape in plants 30 cm. long. Later it becomes ovoid and then piriform. In a plant 30 cm. long the pneumatocyst is one centimeter in diameter. In a plant 50 cm. long the pneumatocyst is 2.5 cm. in diameter and 3 cm. in length. After the plant has attained a length of 3 or 4 meters the pneumatocyst begins to elongate and from that stage until maturity maintains the characteristic retort-shaped appearance finally becoming 2 or even 3 meters in length, in which condition, as long ago noted by Mertens, it is employed by the Aleutians to siphon water from their canoes. By the same tribes, Mertens also observed that the stipe is employed for fishing lines. As learned by Miss Tilden such lines are still preserved as curiosities by a few native fisher-women, but ordinary tackle is generally in use.

Reproductive Area.—The only functional reproductive bodies known to occur in *Nereocystis* are the spores, formed in sporangia. Together with the paraphyses these sporangia produce large soral patches on both sides of the leaf. A sorus may be as much as a meter in length, from 3–7 cm. in width, and on a single leaf three or four such sori may occur, their ends separated by but a few centimeters of sterile tissue. The leaves which bear the sori are rather broader than the sterile leaves. Fruiting patches are very conspicuous on account of their slightly lighter color than the sterile tissues. Oliver writing in 1887 states categorically that nothing is known of the reproduction of *Nereocystis*, but Areschoug in 1876 observed the sporangia and paraphyses together with some young forms, as indicated in his paper in Bot. Notiser, and afterwards in 1884 returned to the subject in his *Observationes Phycologicae* where a brief systematic description is given. My own researches have cleared up the origin of the sporangia and paraphyses and I have been able to follow the development of the sorus from its first inception.

Ecology.—The habit of mature *Nereocystis* plants is to attach themselves in channels where the tides are swift and beds of the plant are to be looked for in tide-ways. I think that plants which are adapted to life in strong tide-ways and tide-rips should be distinguished as a special ecological sub-class of hydrophytes distinct from such plants as *Fontinalis* which grow in river-channels and may be termed *rheophytes.* Previously I have noted the adaptation of certain limnetic plants to withstand the impact of surf and proposed for them the name of *cumaphytes.* I now venture to suggest that plants like *Nereocystis* or *Alaria* be regarded as typical of the tide-way habitat and be known as *palirheophytes.* When the tide is not running the pneumatocysts float more nearly perpendicular and show as round bulbs at the surface of the sea, but when the tide begins to run tension is exerted on the stipe and holdfast and the long retort-shaped pneumatocysts lie lengthwise with the current. The leaves are always somewhat submerged; especially is this true when the tide is running—a habit which protects their more delicate bodies from the destructive friction and impact of the surface. When the tide changes the shifting of the great pneumatocysts is sufficient in force to overturn small skiffs which may be caught among them. But larger boats find a *Nereocystis* bed a safe anchorage if a storm overtakes them while near the rocks of a leeshore, and Puget Sound fishermen often anchor their boats to a dozen of the *Nereocystis* pneumatocysts and have no fear of being blown upon the rocks, so firmly are the hapteres attached to the bottom and so strong are the stipes. In the late autumn the *Nereocystis* dies, for, as long ago noted by Mertens, while one of the largest of the algae it is an annual.

Histology.—The intimate structure of the Laminariaceae has commanded the attention of many careful observers. Among the more important papers that I have consulted may be mentioned those of Postels and Ruprecht (1840), Ruprecht (1848), Thuret (1850), Le Jolis (1855), Agardh (1868 and 1873), Reinke (1875), Janczewski (1875), Areschoug (1876), Foslie (1884), Will (1884), Wille (1885, 1897), Kjellman (1883, 1893), Grabendörfer (1885), Oliver (1887), Rosenthal (1890), Setchell (1891), Guignard (1892), Murray (1893). Few of these make any mention of *Nereocystis*, but since in details of structure the genera of the Laminariaceae are rather similar, all these papers and several others have been of assistance.

In general, as particularly demonstrated by Reinke and Wille, the Laminariaceae have well-marked tissue-areas which may be regarded as in a degree physiologically equivalent to those of higher plants. Cortex and central cylinder are distinguishable in stipes and laminae. Mestome, stereome, tegumentary and photosynthetic areas are well differentiated although the second, to which Setchell's sclerenchyma of *Saccorhiza* may belong, is poorly developed as in most hydrophytes.

The primitive Disc.—Longitudinal sections of a primitive disc belonging to a plant 18 mm. in length showed it to be irregularly circular in shape, .8 mm. in diameter, .1 mm. high. Near the center of the upper side arises the stipe with a diameter of 75 mic. The primitive disc consists of parenchymatous tissue of approximately isodiametrical polyedral thin-walled cells about 12 mic. in diameter. The superficial layer is made up of much smaller epidermal cells similar to those which occur over the stipe and lamina. The layer of cells which is appressed to the substratum—in this case the surface of a *Zostera* leaf—are for the most part similar in shape to the general fundamental tissue of the disc but not much more than half as large. Some of these appressed cells are prolonged into stocking-shaped rhizoids the flat surfaces of which lie very close against the epidermis of the eel-grass. Measurements of some of these stocking-cells showed them to be 7 mic. in diameter, the leg and foot of the stocking each being 15 mic. in length. Just above the area of affixation numerous transverse partitions are visible in the fundamental tissue of the disc and apparently there is here a layer somewhat similar to the cambial zone of higher plants and by it the primitive disc becomes thicker. At the same time divisions in various planes cross the more internal cells of the fundamental tissue and the epidermal cells increase in number by vertical divisions. As elsewhere in the plant the epidermal layer of the primitive disc is abundantly provided with chromatophores, which in my aniline-water-safranin preparations are stained deeply, while the fundamental tissue cells are given a pink hue by the staining of their thin walls. At this age the margin of the primitive disc has not yet become crenate, although the slight irregularities of its circular form will in older material bring about the crenations of the margin which eventually protrude themselves as the primitive hapteres. While the primitive disc is in the condition just described, the medulla of the stipe is sharply distinguished from the cortex by its longer and narrower cells, but the differentiation of sieve-tubes and pith-web has not yet taken place. Rather is the whole area of the stipe made up of prosenchymatous prismatic cells without intercellular spaces and the cortex consists of cells quite similar but considerably shorter. I am not able to distinguish any differences between the epidermal cells of different parts of the plant in this stage of its growth.

Origin of the secondary Hapteres.—Longitudinal sections through the stipe of a plant 12 cm. in length just above the primitive disc which has now increased in diameter to 5 mm., show the origin of the first secondary hapteres. I am not able to make a distinction between a rhizogenous area of the stipe and the rest of that organ, for as has been previously said, callosities which I consider equivalent to secondary hapteres may, under favorable conditions, be produced all the way up the stipe to the pneumatocyst. Those hemispherical emergences of the cortex which are produced close to the primitive disc develop as hapteric branches. The first appearance of the hapteres is as a slight swelling of the cortex and it will be found that this swelling is due to the more active divisions of a cambial layer lying between the central cylinder, now very distinct, and the epidermis. Soon this swelling becomes hemispherical and now the cells of its central portion are elongated in a direction parallel with the axis of the emergence. There is not any definite development of a central cylinder in the haptere, but the whole organ is made up of thin-walled somewhat prosenchymatous cells, covered with the characteristic epidermis, just below which the cells are short and flattened and in a state of rapid division concentrically with the surface of the emergence. In the hemispherical stage of the secondary haptere the central cells lying near the base of the emergence are many of them 150 mic. in length by 45 mic. in breadth, while the cambial cells three or four layers underneath the epidermis are 10 mic. in length and 15 mic. in breadth.

Dichotomy of the secondary Hapteres.—The primary hapteres do not commonly show dichotomy, but remain as crenations of the disc-margin. As the disc enlarges these crenations sometimes become indented and this indentation is equivalent to the sharp characteristic dichotomy of the secondary hapteres. In the latter after the first emergence has elongated into a cylinder with rounded end, the densely protoplasmic character of the apical region where the cambial cells, or meristem, is located, gives a darker appearance to the apex of the haptere. Gradually this apex becomes laterally compressed and an indentation appears at the summit separating two meristematic areas. Longitudinal sections through such apical areas show that the meristem of the exact apex ceases its active concentric divisions, while right and left of this region the divisions continue, thus forming two new apical cones, which continue to develop as before. Forking of the haptere originating in this manner may be repeated a number of times, and thus the much-branched later hapteres of the plant are developed. The cambial zone of the apex extends down the sides of the hapteric branch and is utilized in the progressive thickening of the organ. The haptere may then be regarded as a conic-cylindrical organ surrounded by an epidermal layer concentrically underneath which is a general cambial zone. By the division of the apical region of this zone the haptere increases in length ; by longitudinal divisions in the lateral portions of the zone the haptere increases in thickness. Even in the most mature hapteric branches the lateral cambium is still visible as such and I have not been able to discover that the growth in thickness is definitely terminated except by the cold of the autumn, when the growth of the whole plant ceases and later the individual perishes.

Fixation of the Haptere.—If the end of an hapteric branch comes in contact with the surface of a rock or other object which gives the necessary resistance, a fixation-area is developed. The epidermal cells of the tip lose their chromatophores and the layers just within remain small but thicken their walls. The general shape of the cell-cavities throughout the fixation-area remains very similar to that of the cambial cells from which they were developed. Growth in length is now terminated, but growth in thickness continues. Sometimes one haptere affixes itself to a neighboring haptere, in which case the ordinary fixation-area arises precisely as if the organ had been affixed to a rock, but this obviously cannot be a common occurrence; yet in every holdfast that is fully developed several such fixations of one haptere to another are likely to be met with.

Callosities of the Stipe.—The characteristic verrucose confluent or elongated callosities of the stipe originate from emergences precisely similar to those which in the holdfast region produce the hapteric branches. I have not observed dichotomy in these callosities, nor do their surfaces become modified into definite fixation-areas. Where two long stipes of adjacent plants have become entwined as frequently happens, the callosities are well developed all along the area of contact. Their structure is altogether equivalent to that of the hapteric branches, and as previously noted, I consider them homologous with hapteres. They may be regarded as cushions to prevent abrasion when two or more stipes have become intertwined.

Structure of the mature Haptere.—When full-grown the haptere consists of but four readily distinguishable tissue areas, the epidermis, the lateral cambium, the rather thick-walled fundamental tissue, and the fixation-area. Chromatophores are not so abundant nor deeply stained in the epidermis as in the same layer of the pneumatocyst or laminae, hence the hapteric region is of a much lighter green than the portions of the plant exposed to stronger illumination. The same is true of the epidermal region on the lower portion of the stipe. The cambial area in the mature haptere is still definitely differentiated as such and consists of the characteristic flattened cells with thinner walls than those of the fundamental tissue. The central fundamental tissue making up the great bulk of the organ is composed of rather thick-walled approximately isodiametrical parenchyma. The fixation-area consists of much smaller thick-walled cells shaped like those of the cambium.

Structure of Stipe.—In a young plant 18 mm. in length the stipe was .25 mm. in diameter midway between the primitive disc and the laminar expansion. Cross sections and vertical sections showed a central cylinder .08 mm. in diameter already sharply differentiated. It could be recognized in cross section by the smaller diameter of the cells and in longitudinal section by the greater comparative length. All the cells, however, within the clearly marked epidermal layer could be described as thin-walled parenchyma or prosenchyma. In material of this age mucilage-ducts were not seen, nor had the intercellular spaces of the pith-web begun to originate. The whole stipe was solid and approximately homogeneous. The cells throughout were strongly stained and many of the nuclei showed sharp and distinct mitotic figures.

In slightly older material than that just described the first intercellular spaces begin to appear as clefts between the lateral walls of the central pith cells, and a little later the layer of cells immediately surrounding the primitive pith develops the first sieve tubes, while at the same time the cortex rapidly increases in thickness. In a plant 12 cm. in length the stipe was 1 mm. in diameter and the central cylinder measured .25 mm. across. In this stage the pith-web made up of loose, anastomosing, branching, septate filaments is well established. The filaments of the pith-web at this time measured about 10 mic. in diameter. Between the meshes of the loose network an abundance of slime was present. At the periphery of the pith-web lay the "sieve-tubes," as they have been termed, the development of which from ordinary cortical cells was not difficult to follow. Most of the centrally disposed sieve-tubes appeared very much smaller and thicker walled in the cross section than did the peripheral elements. This was due to the longitudinal stretching of the inner and older tubes. In most of the cross sections through this material the sieve-tubes stood in radiating lines of three or four to each group. Although the trumpet-hyphae, reserving this term for the sieve-tube-like elements of the pith-web in contradistinction to those developed from the cortex, were not yet apparent in my 12 cm. material there were some perforated transverse walls visible in the ordinary anastomosing filaments of the web. Although my stains have not been nuclear some excellent mitotic figures were visible in this preparation.

Longitudinal sections through the 12 cm. material show the cortex to consist in general of thin-walled parenchymatous tissue made up of cells about twice as long as broad in the layers close to the epidermis but becoming progressively longer and slenderer towards the central cylinder, until those cells bounding the pith-web become transformed into the sieve-tubes. The pith-web cells are attached to the sieve-tube cells and to the undifferentiated layers just outside of the sieve-tube zone. The young sieve-tube is indistinguishable from an ordinary prosenchymatous cell of the inner cortex. The nuclei of some inner cortex cells undergo fragmentation and then these cells are greatly elongated as the stipe grows in length. As one elongates it becomes much narrower, so that while the diameter of the cell from which a sieve-tube originates may be 12 mic. and the length 80 mic. the diameter of the sieve-tube which arises from it may in its thinnest portion be scarcely more than 1 mic. while the length may exceed a millimeter! Cross sections through the slenderest part of such a sieve-tube show its wall to be thickened like a thermometer tube, while the cell contents, deeply stainable with aniline blue, fill the extremely delicate capillary cavity.

Observation of a series of longitudinal sections makes it seem probable that the first sieve-tubes formed, and many of the successive tubes, are elongated to such tenuity that they finally pull apart in the middle and then the free ends of the tube deliquesce into the common gelatinous slime of the pith-web leaving only the thickened so-called callus patches attached to the remnants of the tube and even these may disappear. The centrifugal production of sieve-tubes continues vigorously while the stipe is young, but in old material not so large a number proportionately are to be found. The stretching of the sieve-tube has all the appearance of a passive extension of the cell, while cross partitions are still being formed in the cortical region outside of the sieve-tube area. I believe that the fragmentation of the nucleus preventing the regular development of cross partitions in the mother-cell of the sieve-tube is the occasion of its failure to divide further and of its consequent passive elongation.

It was in this 12 cm. material that the best examples of cryptostomata were discovered. I shall return to their discussion later while considering the lamina. It suffices to mention at this point that these peculiar piliferous organs of doubtful morphological significance are present upon young stipe as well as upon young lamina, but in mature plants I have not seen them.

Origin of the Pneumatocyst.—A continuous ribbon of 3 mic. sections was taken across the area of the pneumatocyst. The series begins in definite stipe area, traverses the pneumatocyst and ends in the base of the lamina. The plant measured 12 cm. in length. In the undoubted stipe area the pith-web is seen to have its meshes filled with gelatine and the first appearance of the pneumatocyst is a small rift in the jelly near the center of the pith-web. As the series passes over through the pneumatocyst this first rift is seen to increase in size and others appear near it. At the same time a distinct flattening of the stipe takes place and it is worth noting that the primitive pneumatocyst is clearly elliptical in cross section rather than spherical. As the series continues across the pneumatocyst area rifts in the jelly of the pith network become smaller. The flattening of the whole area becomes more marked and in the base of the lamina the section has become five or six times as long as it is broad and shows the undoubted lamina characters. The pneumatocyst, stipe and lamina are essentially the same in structure, but the bubble which forms in the pith-web of the pneumatocyst area increases very rapidly in size and the vesicle thus formed becomes finally the greater retort-shaped organ of the mature plant.

Structure of older Stipes.—As the plant increases in size the stipe continues to thicken by concentric walls which appear in several of the sub-epidermal layers of the cortex. A plant 12 dm. in length showed a stipe 5 mm. in diameter of which the central cylinder occupied 1.5 mm. In material of this age the cortical cells have not yet developed the characteristically thick walls of mature stages, but mucilage canals are now in evidence, a circle of them appearing subepidermally. I am able to confirm Will's and Guignard's account of their development. They originate by vertical radial partitions of certain cortical cells in the cambium region. Just outside of the two cells thus formed a cleft appears and this cleft increases in size while the two small cells within divide by other vertical and transverse partitions finally coming to line the half of the canal which faces the central cylinder. These small cells are the secretion-cells. They do not persist but after a time break down so that in mature portions of the stipe the mucilage-duct in cross section appears merely as a circular-outlined intercellular space.

It is in material of the same age or younger that one finds well-developed trumpet-hyphae intermingled with the ordinary anastomosing filaments of the pith-web. While these cells do not become nearly so attenuated as the sieve-tubes, they are nevertheless slenderer and three or four times as long as the ordinary cells of the pith-web. Their ends, where two come in contact, are much swollen. I have not been able to discover whether fragmentation of the nucleus precedes the formation of a trumpet-hypha as it does that of the sieve-tube. Neither my Russow's callus reagent nor corallin-soda gave results such as those which Oliver obtained, nor have I been able by microchemical methods to demonstrate the presence of true callus, such as has been announced for the sieve-tubes. This is possibly owing to the preservatives which have been applied to the tissues, or their age, but I am inclined to accept rather the views of Wille regarding the callus than those of Oliver. No evidence of protoplasmic connections between adjacent sieve-tubes or trumpet-hyphae has been obtained. At this point it is well to state definitely that the material I have examined seems to show clearly that there are two very different kinds of tubular cells with perforated end partitions. Wille, in criticising the results of Oliver, who made a distinction between trumpet-hyphae and sieve-tubes, seems to suggest that there is only one category of such cells and that differences are of degree and not of kind. According to my observations the trumpet-hypha does not become extremely attenuated nor does it develop the thermometer-tube cell with capillary lumen such as characterizes the sieve-tube. Since the morphological position of the two kinds of cells in the stipe is different, since their origin is different, and on account of their very easily distinguishable structure, I can but follow Oliver and maintain them as separate structural elements not to be confused on account of their similar perforated end-plates. They are abundant in older material but the relative proportion of the two varieties of cells changes. While in young material an abundance of sieve-tubes is characteristic, in old material the trumpet-hyphae are abundant and but few sieve-tubes remain, most of them having undergone extreme attenuation and subsequent degeneration.

Structure of mature Stipe.—Cross sections through the stipe of a plant 25 meters in length showed its diameter to be 10 mm., of which the central cylinder comprised 2.5 mm. In this material the cambium zone lying four or five layers within the epidermis is still distinct. Numerous mucilage canals are present, most of them lying in the concentric circle first developed and now separated from the periphery of the stipe by numerous layers of cortex developed after their formation from the cambium. The average size of cortical cells in cross section is about 25 mic. Their walls, however, are now distinctly thicker than at first and at the angles between the cells the thickening is sometimes increased giving to the tissue a collenchymatous appearance. By the thickening of the walls great elasticity and strength is given to the stipe. Intermingled with the large cortical cells are many smaller ones averaging 10 mic. in diameter. The central cylinder in the mature stipe consists of a loose pith-web of anastomosing filaments, imbedded in gelatine, among which abundant large trumpet-hyphae are apparent. Many of the trumpet-hyphae connect by lateral processes with the ordinary filaments which are not more than half as great in diameter. In material of this age the sieve-tubes are very difficult to find, almost all of them having been destroyed. This is not what Oliver means by his phrase "obliteration of sieve-tubes" for he applied that term to the closing of the plates by his callus-like substance, nor can I learn that the fact has previously been recorded. Oliver mentions that the true sieve-tubes are abundantly branched. In my opinion this is a mistake. Anastomoses occur between sieve-tubes and the formative layer of the cortex from which they arise, but I have seen no true anastomoses between the sieve-tubes and the hyphae of the pith-web, nor have I observed any branching of the sieve-tubes by the formation of lateral emergences such as are so common in the trumpet-hyphae. The great abundance of the trumpet-hyphae and their peripheral position, as well as central, in the pith-web may easily have given rise to a misconception.

Structure of the Pneumatocyst Wall.—Sections of a pneumatocyst wall taken from a plant 12 dm. in length in which the pneumatocyst was approximately spherical and 4 cm. in diameter showed the wall of the cyst to be 4.5 mm. thick. The epidermis is not essentially different from other epidermal tissue and in the subepidermal regions a cambial layer is present by divisions of which the wall is thickened. The older cortical cells throughout the pneumatocyst wall have their long diameters parallel with the radii of the organ, until an inner cambial zone is reached close to the cavity of the cyst. Here the cells become tabellar in form with their long axes parallel with the surface. The pith-web is altogether destroyed, but in this material characteristic elongated sieve tubes with narrow lumina are present. The presence of such an inner cambial zone seems to be peculiar to the pneumatocyst area and in this zone numerous transverse as well as concentric walls are constantly being formed. The intermediate area between the inner and outer cambium, as the pneumatocyst matures into the retort-shaped body, finally comes to consist of cells elongated in the axis of growth rather than as at first perpendicular to this axis.

Structure of the young Lamina.—The basal structure of the lamina is identical with that of the stipe. Like the latter it must be considered to consist of central cylinder—in this case a very thin plate of cells—of cortex and of epidermis. My serial sections through stipe, pneumatocyst and young lamina show the progressive change from the cylindrical through the oval and elongated-oval to the thin ribbon-shaped section and enable the homologies of the various areas of the lamina and stipe to be exactly determined. Cross sections through the lamina of a plant 18 mm. in height showed the thickness of the lamina to be a little over .1 mm. while from edge to edge the lamina measured 4 mm. The most marked difference between young lamina and stipe is the early development in the former of mucilage canals which lie in rows just within the epidermis. The cortex in this stage consists of about two layers of cells, those just under the epidermis being generally larger than the ones which abut upon the plate of cells regarded here as central cylinder. The secretion cells of mucilage ducts in this material seem to line the canal not only along the inner side but along the outer as well. They stain deeply with aniline-water-safranin. The cells of the central plate are narrow, much thicker-walled than those of the pith-web in the stipe and packed together in such a way as to leave only very small intercellular spaces. Many of them run crosswise of the leaf while others run lengthwise. The result of this is to make this area not dissimilar to the same area in longitudinal section, but as the leaf matures the pith-web character of the middle lamella becomes more marked and trumpet-hyphae are present in longitudinal sections of the lamina of a 12 cm. plant. In a leaf of this size the cortex consists of five or six layers of cells, the inner larger than the outer, but along the middle lamella the cortical cells are smaller and elongated in the axis of the leaf. Where they abut on the middle lamella they pass over into the character of pith-web tissue. By the time the leaf has acquired this size the secretion-cells of the mucilage ducts have for the most part broken down and cryptostomata have developed in the furrows which lay over the mucilage ducts of the younger leaf. The epidermal cells in young leaves are about three times as broad as they are high, are densely protoplasmic and stain vividly. Interesting rows of short cylindrical cells are found in the pith-web, their diameter sometimes exceeding their height. Such cells finally become elongated into the ordinary hyphae of the web. Cross sections of the leaf of a 12 centimeter plant show some sieve-tubes still present and more abundant in the growing region of the leaf which is essentially basal.

Towards the tip of the leaf the lamina is thinner in the 12 cm. material, the epidermal cells are more nearly square in outline, the cortical cells are very large and approximately isodiametrical, while the central lamella is reduced to about two layers of thick-walled cells of elongated shape with few intercellular spaces. From this region mucilage ducts and sieve-tubes are absent for it was formed before the time of their differentiation, nor are cryptostomata abundant toward the tip of the leaf.

Splitting of the Lamina.—From a series of sections taken through young laminae of a plant in which the first cleft is beginning to appear I have been able to determine the origin and occasion of the cleft. In *Nereocystis* the cleft does not appear to be of the nature of a wound as said by Professor Setchell of the similar phenomenon in *Saccorhiza dermatodea*, but it seems to take place in this way: A single row of cortical cells immediately below the epidermis deliquesces or collapses and the epidermis furrows along the depression. The deliquescence is propagated to adjacent cells right and left of the furrow and continues down to the middle lamella. This furrowing may take place along one surface of the leaf or along both surfaces until the epidermal cells come to lie against the middle lamella. The latter then breaks down and the two epidermises at the bases of the furrows are contiguous. The split takes place along the base of the furrow and leaves the two halves of the lamina with apparently normal unwounded edges. In some cases the cortex cells come down together over the edge of the deliquescing central lamina so that it is extremely difficult to distinguish between the original edge of the lamina and the edge of the cleft. The epidermis suffers no disintegration during the process. The actual cleavage of the lamina may be due, as Professor Setchell suggests for *Saccorhiza*, purely to the impact of the waves upon the weakened structure, but it may also be due to a definite separation of the epidermal cells from each other by a chemical change in their walls. The furrow of the epidermis seems to deepen, destroying the inner cells of the lamina as it progresses. The split takes place first in the more complex basal portion of the leaf and is perpetuated to the tip. I have not been able to determine whether the cleft is propagated in this manner clear to the simpler primitive-tip end of the leaf, or whether it becomes a mechanical cleft of the nature of a wound when it reaches the distal end of the lamina.

No evidence has been secured to indicate that there is any renovation of the lamina in *Nereocystis* such as is well known to take place in some of the Laminariaceae.

Structure of the Cryptostomata.—The organs of the young stipe and lamina which are with some hesitation termed cryptostomata appear as short, irregular furrows from the surface of which tufts of two- or three-celled hairs are produced. They are not so conspicuous in *Nereocystis* material that I have examined as those of *Adenocystis*, *Alaria* and *Saccorhiza* described by Kjellman and Murray. I have failed to find them save on young plants less than half a meter in height. Various suggestions have been made by different students of the Phaeophyceae regarding their significance. By some they are regarded as vestigial reproductive tracts, but it will be unnecessary to go into this further than to make the suggestion that the areas classed as cryptostomata in different genera of brown algae are not by any means necessarily to be considered as everywhere the same. Indeed it is quite clear that in the Splachnidiaceae and Laminariaceae they are probably of different significance from those of Fucaceae. They stain deeply with aniline dyes in *Nereocystis* and I suspect from this fact that I have not seen mature stages of the hairs. There is a possibility that the mucilage canals are invaginated furrows and that the so-called cryptostomata are developmental stages of these, but I have not satisfied myself upon this point.

Primitive Furrows of the Lamina.—An interesting character which is to be noted in very young plants is a longitudinal furrowing of the lamina by parallel grooves which occur on both sides, each groove lying over a mucilage canal. In the primitive tip where mucilage canals are absent the furrows also are absent and leaves two or three centimeters in length have lost these furrows as may be seen in cross section, but in plants 1–2 cm. in height a deep furrow lies over each longitudinal mucilage canal just within the epidermis. Something of an appearance similar to that of young *Costaria* plants is given by these longitudinal furrows. But in *Costaria* the striation of the lamina arises, as shown by cross sections, from ridges which structurally belong to the cortex and over which the epidermis is elevated by the growth of inner portions of the lamina. Nor in *Costaria* do the ridges bear the same relation to mucilage ducts that is borne by the primitive furrows in the *Nereocystis* sporeling. Indeed I have not observed mucilage ducts in young *Costaria* laminae.

Origin of Secretion-cells in the Lamina.—It has already been noted that the secretion-cells seem to line all sides of the mucilage duct in young lamina while in young stipe they occur only on the side of the duct which is toward the central cylinder. The occasion for this seems to be explained by some of my sections which show the first division-wall of the primitive secretion-cell parallel with the face of the lamina instead of perpendicular to the surface as in the stipe. The cleft then arises between these two small cells, one lying peripherally and one centrally. But in the stipe the first cleft appears in a plane perpendicular to the surface and not between the two primitive secretion-cells, but between the cells just peripheral to them. I do not like to speak with positiveness upon this point since it is at variance with the results of previous investigations upon other genera, and but a few of my sections are helpful.

Growth of the Lamina in Length and Thickness.—As in other Laminariaceae each lamina of *Nereocystis* grows by a generally basal area which lengthens in both directions, so that the elongation of the lamina is neither strictly basipetal or acropetal. The thickening of the lamina, which finally, in old leaves, comes to consist of from five to ten cortical layers on each side of the central lamella which is itself made up of a rather compact pith-web tissue eight or more layers across, goes on in the general basal area of growth. Old laminae are of a mature type of structure from base to tip since the original thinner primitive tip area has been worn away by the action of the waves and the disappearance of the primitive tip is often to be noted even in very young plants less than 12 cm. in length.

Origin of the Sorus.—The sorus of *Nereocystis* in its structure and origin is altogether typical of the family. The first evidence of the sorus is marked by transverse divisions in the epidermal cells parallel to the surface of the lamina. In this way a double layer of somewhat larger deeper-stained superficial cells and smaller cubical more dimly-stained sub-epidermal cells comes into existence. The superficial cells elongate into the club-shaped paraphyses which finally come to be 30–40 mic. in length, about 7 mic. in diameter at the capitate tip and 2 mic. or even less where they join the basal cells. The sporangium originates as an hemispherical bud on the basal cell beside the paraphysis. By the attenuation of the paraphyses as they elongate space is afforded the sporangia for their development. In half-mature sori in which the paraphyses were 20 mic. in height the sporangia could be seen as ellipsoid cells about half as long and of quite different shape from the already club-shaped paraphyseal cells. In mature sori, however, when the spores have been formed in the sporangia the difference in the height of the two cells is not so great and the paraphyses overtop the sporangia by but about 10 mic. or even less. The distal end wall of the paraphyses is thickened as in other genera of the same subdivision of the family.

Free zoöspores have not been seen but sporangia ready to open have been found and the spores appear as hyaline cells close to 1 mic. in the short diameter and a very little longer transverse to this. The sporangia doubtless open at the tip to discharge the hundred or more spores contained in each. The end wall of the sporangium, like that of the paraphysis is often considerably thickened. I am able to confirm upon *Nereocystis* material the results of Thuret who noted in 1850 the separation of a thin cuticular pellicle from the surface of sori in *Scytosiphon*, *Laminaria* and some Fucaceae. This pellicle retains the partition-markings of the original epidermal cells quite as figured by Thuret for *Laminaria saccharina* and *Scytosiphon lomentarius.* The exact manner in which this pellicle is separated does not yet appear to be clearly understood, nor am I able to say more about it at this time than that the wall of the soral surface when young seems to be lamellose and the separation of the cuticular pellicle seems to take place by the dissolving of one of the lamellae. Before the separation a few very small bodies, red-stained in aniline-safranin preparations are seen lying against the inner face of the distal wall of each paraphysis. It is possible that they assist in the secretion of the thick pellicle which is finally sloughed off. Sometimes two transverse divisions precede the formation of the paraphysis in which case two layers of floor-cells are produced in the sorus. One or two jointed paraphyses have been seen. The paraphysis seems never to consist of more than two cells and the two-celled condition is extremely rare.

I am under obligation to Miss Josephine E. Tilden for putting at my disposal an abundance of carefully preserved material and to Mr. Harold Lyon for assistance in the tedious routine of microtomy. The drawings were made by Miss Tilden under my direction.

Explanation of Plates.

PLATE 361

FIG. 1. Plant .1 mm. in length. Shows primary differentiation of holdfast and stipe-laminar region. Enlarged.

FIG. 2. Plant 1 mm. in length. Stipe is already elongated. Tip of lamina is removed. Enlarged.

FIG. 3. Three young plants, each one-half natural size. The smallest was 6 mm. in length, the next 18 mm. and the largest 4.5 cm. These plants show the early rapid enlargement of the laminar area.

FIG. 4. A plant 14 cm. in length, reduced one-half, showing the origin of the first cleft near the base. The stipe is proportionally undergoing more rapid elongation in this stage

FIG. 5. Pneumatocyst and laminar bases from a plant 50 cm. in length. Reduced one-half. Showing how only the first cleft reaches the surface of the pneumatocyst.

FIG. 6. Vertical section of primary fixation-area, showing rhizoid cells. From plant 18 mm. long. × 335.

FIG. 7. Diagrammatic cross section of stipe. Sieve-tubes represented as dots. Plant 12 cm. in length. × 25.

FIG. 8. Diagrammatic cross section through pneumatocyst of plant 12 cm. in length. Black spaces in central cylinder represent clefts in the gelatinous matrix. × 25.

FIG. 9. Diagrammatic cross section through base of primary lamina. Plant 12 cm. in length. × 25.

FIG. 10. Cross section through pneumatocyst of 12 cm. plant. Peripheral region. × 335.

FIG. 11. Cross-section through pneumatocyst of 12 cm. plant. Sieve-tube region. × 335.

FIG. 12. Diagrammatic cross section of lamina in 18 mm. plant. Mucilage ducts and grooves are indicated × 25.

FIG. 13. Detail of laminar structure. Cross-section 25 mm. above the top of the pneumatocyst in 12 cm. plant. × 335.

PLATE 362

FIG. 14. Cross section through base of lamina in 12 cm. plant showing groove, which initiates the longitudinal division of the laminae. 25 mm. above top of pneumatocyst. × 335.

FIG. 15. Cryptostomatal area. Cross section immediately above pneumatocyst of plant 12 cm. in length.

FIG. 16. Sieve-tube from stipe. 12 cm. plant. Shows the fragmented nuclei in the capillary cavity of the cell. × 335.

FIG. 17. Trumpet-hypha from pith-web of plant 12 dm. in length. Shows gelatinous thickening of inner wall. × 335.

FIG. 18. Origin of sieve-tubes. Longitudinal section through area bounding the pith-web. Plant 12 cm. long. Cells to the left with several nuclei become passively elongated into the sieve-tubes. × 335.

Fig. 19. Cross section of mucilage duct in the lamina. Section made immediately above pneumatocyst. Plant 12 cm. long. × 335. Should be compared with Fig. 15 and indicates a possible relation between the structures classed as cryptostomata and the mucilage ducts.

Fig. 20. Cross section of old mucilage duct in stipe. Plant 12 cm. long. Secretion-cells not shown. × 335.

Fig. 21. Cross section of pneumatocyst wall. Mucilage duct in center. × 335.

Fig. 22. Origin of paraphyses in sorus. Mature plant. × 335.

Fig. 23. Origin of sporangia in sorus. Mature plant. × 521.

Fig. 24. Cross section through mature sorus showing paraphyses and sporangia. In the latter spores are indicated. × 335.

Studies in Sisyrinchium, II:—Four new Species from Michigan.

By Eugene P. Bicknell

As represented in Michigan the genus *Sisyrinchium* presents some altogether unexpected features. As many as eight species occur in the state, that is to say, eight species are included among several small collections of Michigan Blue-eyed Grasses which have been sent to me; it is quite probable that the actual number of species belonging to the state flora is even in excess of this. Two of the species are the now well known *S. angustifolium* and *S. graminoides*, common in the eastern states; two are long discredited species which must be restored to good standing—the *S. mucronatum* of Michaux, described in 1803, and the *S. albidum* of Rafinesque, published in 1832; about these I shall have more to say on another occasion; the remaining four species are here described.

It does not yet appear which are the prevailing species in the state. *S. graminoides* seems to have been the most frequently collected, occurring both north and south, but it is apparently quite wanting in certain sections. *S. albidum*, which is common further south, seems to prevail in the southern part of the state, where it has been collected by Professor Wheeler, Mr. Farwell and the Misses Camp; Mr. Farwell has also obtained it in Keeweenaw County in the extreme north. *S. angustifolium*, common eastward, and also to the north and west, appears to occur only sparingly. The four new species must be regarded for the present as rare, each having been collected only at a single station.

Sisyrinchium hastile

Very slender and rigidly erect, apparently little if at all tufted, 30–40 cm. high, dull green becoming brownish in drying. Leaves very narrow and stiff, thickened, 1 mm. or less wide but becoming over 30 cm. long, tapering into a very slender, obtusely pointed, sometimes terete apex, very closely striate-nerved, granulose-roughened throughout with minute whitish points, except the broadened and membranous sheathing base; stems resembling the leaves, equally slender and granulose, rigid and very straight, or sometimes twisted and undulate, strongly striate, not at all winged but subterete and bluntly two-edged or obscurely margined: spathes in a conjugate pair at the top of the stem, or sometimes solitary, the outer one stoutly short-stipitate within the base of the common outer bract, each spathe consisting of two opposite pairs of closely imbricated bracts 2–3 cm. long which are attenuate-lanceolate, stiff-membranous and striate, with hyaline margins, the inner pair tapering into weak white-scarious acuminations, all glabrous or the outermost obscurely roughened, the common outer bract very slenderly prolonged for half its length and surpassing the inner ones 1–5 cm.; interior scales ample, sometimes slightly exserted, the larger ones even appearing like inferior bracts: flowers apparently only 1–3 in each spathe, on erect, scarcely exserted pedicels 1.5–2.3 cm. long, mature flower not seen; a dried and brown bud from within a spathe showed unusually long and narrow anthers (4.5 mm. long) cleft for the insertion of the short, partly free filaments, and slender styles about 2 mm. long not, however, surpassing the stamens: young capsule obovate-oblong, dark, rugulose.

Described from a few imperfect specimens communicated by Mr. O. A. Farwell, who collected them June 6, 1896, on "sandy shores of Belle Isle, in the Detroit River, Michigan."

A remarkable plant not closely related to any of our species, but showing a number of striking peculiarities and even possessing claims to generic distinction.

Sisyrinchium Farwellii

Thinly tufted from a cluster of very slender wiry roots which are dark and finely striate when dried, the bases of the tufts sheathed with a coating of coarse dull-brown fibers. Leaves and stems rather light dull-green and slightly glaucescent, not blackening in drying, the spathes paler yellowish-green: leaves apparently not more than half the height of the stem, becoming 3 mm. wide, firm in texture though rather thin and membranous, finely nerved, attenuate-acute, the edges smooth or serrulate: stems flexuous-erect, 20–30 cm. high, 1–2 mm. wide, the wings thin and finely nerved, minutely aculeolate-serrulate or sometimes smooth below; bracteal leaf shorter than the two or three peduncles, slenderly attenuate, below rather abruptly broadened and loosely clasping, the membranous sheathing base striate-nerved, the keel sometimes very rough-serrulate, stem sometimes bearing two rather distant nodes each with its leaf and peduncles: peduncles 4–11 cm. long, somewhat curved, approximate, very slender, mostly less than .5 mm. wide, narrowly thin-margined, smooth to ciliolate-serrulate, sometimes serrulate only on one side: spathes narrow but abruptly broader than the peduncles, erect or slightly bent, 17–20 mm. long, bracts sub-equal or the outer one slightly prolonged, thin and membranous, narrowly hyaline margined finely or sometimes obscurely nerved, narrow and attenuate, slender-pointed or sub-aristulate, or the inner one mucronate from a scarious apex, the outer one clasping for 2–3 mm. at base: interior scales about half the length of the bracts: flowers 5–9, pale-blue, very small; perianth appearing to be only about 6 mm. long, very delicate and faintly-nerved: capsules pale and thin-walled, 3–5 mm. high, on slender, somewhat flexuously-erect, exserted pedicels, 17–25 mm. long.

Southeastern Michigan, Birmingham, Oakland County, September 27, 1898, O. A. Farwell.

Very distinct from any species of the Eastern States, appearing to group more naturally with the fibrous-based *S. Floridanum* and allied species of the South.

Sisyrinchium strictum

About 30 cm. high in close tufts not fibrous-coated at base, pale, bright green and glaucous, keeping its color when dried, the spathes often purple and sometimes the entire plant purplish-tinged. Leaves over half the height of the stems, closely erect, rather thin, but firm and closely striate-nerved, 1–2 mm. wide, slenderly acute, the edges minutely serrulate to smooth; stems about 1.5 mm. wide, the wing-margins rather thin, mostly serrulate; node only one, bearing a slender erect bracteal-leaf, shorter or longer than the mostly two short, erect, approximate peduncles which are narrowly wing-margined with denticulate edges: spathes erect, narrowed into the peduncle, 16–20 mm. long, 1.5–3 mm. wide, the bracts subequal, but usually the inner one slightly surpassing the outer and obviously the broader above, acute or mucronulate, rather openly fine-nerved, almost carinate, the dorsal line of the outer bract usually showing a more or less abrupt descent into the acuminate apical part, the margins below slightly hyaline, united for about 5 mm. above the base; interior scales small, half the length of the bracts or less: flowers 3–6 on erect, slightly exserted pedicels 20–23 mm. long; perianth deep blue-purple, apparently about 10 mm. long; stamineal column about 5 mm. high; pedicels distinctly margined or even winged, the exserted tips becoming purple: a single capsule is truncate obovate, pale and thin-walled over 4 mm. high: seeds not quite mature, oblong, dark and rugulose-pitted, 1–1.25 mm. in longer diameter.

Vestaburg, Montcalm County, Michigan, collected by Professor C. F. Wheeler, June 22, 1898, "in sandy soil well in the southern limits of the white pine country."

Appearing somewhat intermediate between forms of *S. Atlanticum* and *S. mucronatum* Michx., but unmistakably distinct from either.

Sisyrinchium apiculatum

Loosely tufted from contractedly branched rootstocks and slender wiry roots, pale green and glaucescent not turning dark when dry, about 40 cm. high. Leaves loosely erect, apparently few and less than half the height of the stems, 1.5–2 mm. or more wide, acute, thin but firm, closely striate-nerved, very smooth-edged, somewhat withering-persistent and becoming loosely flexuous and fibrillose about the base of the tufts ; stems erect, 1–2 mm. wide, narrowly winged ; nodes mostly two, separated by an interval of 4–6 cm., the lower bearing a foliaceous erect bracteal-leaf and one or two peduncles often much surpassing the second node, which supports a short bracteal leaf and two or three peduncles ; peduncles very slender, narrowly margined, smooth or finely denticulate, distinctly constricted at the base of the spathe, erect or divergent, those from the first node sometimes 8 cm. long, the upper ones shorter : spathes often deflected, short and relatively broad, 10–13 mm. long, 2–3 mm. wide, the bracts subequal, mostly incurved above, acute, or the inner one sometimes obtuse, prominently striate, broadly hyaline-margined, convex and sharp-edged, the inner one emerging rather abruptly above the clasping base (3–4 mm. long) of the outer one ; interior scales rather broad and blunt, much shorter than the bracts, flowers about 6, blue, rather small ; perianth about 8 mm. long ; stamineal column about 4 mm. high ; ovary glandular-puberulent : capsule dark, broadly subglobose, apiculate, sparsely puberulent, on loosely erect, distinctly margined pedicels, 13–17 mm. long.

Muskegon, Muskegon Co., Michigan, June, 1898, communicated by Professor W. J. Beal.

In appearance perhaps most suggestive of *S. Atlanticum*, but not at all that species.

Notes on Covillea and Fagonia

BY ANNA MURRAY VAIL

Dr. B. L. Robinson (Syn. Fl. **1**: 356) has pointed out that the leaflets of *Larrea divaricata* Cav. are more narrowly oblong, more widely spreading and are less inclined to be falcate as well as more decidedly connate than are those of *Larrea Mexicana*. Mr. F. V. Coville recently (in litt.) also claims that however closely related, the southwestern species is distinct from the Chilian species. The plant on which I based my examination of *Larrea divaricata* was a duplicate of the "Macrae" specimen mentioned by Dr. Robinson and it is undoubtedly *L. Mexicana*. Since then I have seen the following specimens from South America (Herbarium of the British Museum) purporting to be *Larrea divaricata*: Lorenz, no. 105; Cordoba, G. Hieronymus, "5, 6, 1877"; South Am., Pearce; Chili, Bridges, 1843, and a specimen from Patagonia which is identical with one from Rio Negro, North Patagonia, from the Wilkes expedition in the Herbarium of Columbia University. They all agree with the differences referred to by Dr. Robinson and in addition I will add that they do not appear to be quite so resinous as the North American plant and the fine silky pubescence of the young leaves seems to be more abundant and to persist longer; the venation is also more distinct. There are some North American specimens, however, which approach very closely to *L. divaricata* and among them I noted one collected at "El Paso, New Mexico," by H. Carruthers, Nov. 10, 1884, in the Herbarium of the British Museum and a specimen without flowers or fruit collected by Frémont on his expedition to California in 1849 (Herb. Torrey).

The synonymy of these two species should therefore stand as follows:

COVILLEA DIVARICATA (Cav.) Vail, Bull. Torr. Bot. Club, **22**: 229. 1895

Larrea divaricata Cav. Ann. Hist. Nat. **2**: 122. 1800. Cav. Ic. **6**: 40. *pl. 560, f. 1.* 1801.

Covillea tridentata (DC.)

Zygophyllum tridentatum Moç. & Sessé; DC. Prodr. **1**: 706. 1824; A. DC. Calques des Dess. *pl. 159.*

Larrea Mexicana Moric. Pl. Nouv. Am. 71. *pl. 48.* 1833–46.

Larrea glutinosa Engelm. Wisliz. Rep. 9. 1848.

Zygophyllum Californicum Torr. & Frém.; Frém. Rep. 257. 1845.

FAGONIA CALIFORNICA Benth. Bot. Sulp. 10. 1844.

A type specimen of *F. Californica* var. *Barclayana* Benth.* in the Herbarium of the British Museum is puberulous as described, but does not show the very marked and conspicuous gold-colored glands of *Fagonia Californica* var. *glutinosa* Vail (Bull. Torr. Bot. Club, **22**: 229). The species is very variable and it is doubtful whether any of the forms described deserve varietal rank.

COLUMBIA UNIVERSITY, May 19, 1899.

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* Syn. Fl. **1**: 355.

Notes on Plants of the Chicago District

By E. J. Hill

In studying the flora of a restricted region, no matter how carefully it seems to have been explored, one is frequently surprised by finding new things. It almost seems as if such plants ought to be classed with those which are known to be introduced, like many migrants along the railways or escapes from gardens. But they are really old residents that had failed to be detected. No region can be regarded as thoroughly explored till every acre of its wild areas at least has been examined. Then some plants are so rare or local or grow under such peculiar conditions that a few square rods or even feet may comprise their range. This is said of the flowering plants and the vascular cryptogams. When we come to the lower orders of plants the space occupied by a given species may be still more restricted. I have in mind a single elm tree to a hollow knot of which I must go to get a little moss, *Anacamptodon splachnoides* Brid., though I do not suppose it is confined to that one knot of all the like hollows which may be found in the region traversed. But the problem is to find the other places, something I should value in its bearings on work pertaining to the geographical distribution of the mosses of the Chicago region. Yet eight years have passed without additions to that hollow space, fortunately so low down on the trunk as to be in easy reach of eye and hand. Bearing this in mind, together with the purpose of extending the range of some plants well known elsewhere, or more particularly indicating their presence here if within their general range as hitherto given, the following notes have been prepared. They are mostly plants detected in the Chicago area during the past two seasons, and such remarks are added as may serve to elucidate their character. The plants are also largely from the dune region at the south end of Lake Michigan, a tract with a remarkably varied flora, whose sand hills, hollows and swamps are an unfailing delight to botanists. They are arranged in groups the better to compare and indicate their range.

The most striking of these are such as have ascribed to them an Atlantic coast range or occur eastward of the Alleghanies, extending in some cases along the coast to the southwest to Louisiana, Texas and Mexico. I have ceased to be surprised at this since first meeting with such plants in 1870 growing on the sandy terraces or the bordering wettish lands along the Kankakee river in Illinois. All of these have since been traced to the dune region of Lake Michigan, or have had their range extended to other parts. But some of them have not yet had intermediate stations recorded for them till the Atlantic slope is reached, like *Rynchospora cymosa*, *Eleocharis capitata* and *E. melanocarpa*, unless they occur inland farther to the south. To these may now be added *Panicum verrucosum* Muhl., *P. lanuginosum* Ell., *Scleria Torreyana* Walp., *Psilocarya nitens* Wood, *Xyris Caroliniana* Walt., with a range from Massachusetts or New Jersey south to Florida, or along the gulf to Louisiana and Texas, and, in the case of *S. Torreyana*, to Mexico. *Psilocarya scirpoides* Torr. occurs with *P. nitens* but has a more restricted range along the coast, "eastern Massachusetts and Rhode Island." Perhaps there should be added to these *Rynchospora macrostachya* Torr., which is made a variety of *R. corniculata* A. Gray and given the same range as the type in Britton and Brown's "Illustrated Flora," but in the older books is confined to the coast region. It is well marked, its long slender spikelets erect or but slightly spreading. It is remarkably abundant where it occurs, like grass in a meadow, and very striking with its prominent brown spikes. *Xyris Caroliniana* spreads over considerable areas making masses of yellow beds in the less grassy portions of desiccated or partially desiccated sloughs in the summer season. The two *Psilocaryae* are specially noteworthy, growing in company in the muddy borders of sloughs, usually in dense masses, so that a single handful will show specimens of both kinds, but so distinct that a little practice enables the eye to separate them without resort to a lens to examine their achenia, which is the final test. Though so close together it is hard to find a specimen that is intermediate in character or classed without difficulty with its appropriate type. I know few plants of any genus so intimately associated that maintain their characters so uniformly and so plainly show that they are specifically distinct. Though frequently intermingled in the same ground-bed they usually occupy in mass different areas whose borders overlap, *P. scirpoides* more abundant, taller and stouter. It is interesting to note also that the spikelets are often much changed in appearance by a rust, probably the same which Torrey mentions in the original description of *P. scirpoides* in his "Monograph of North American Cyperaceae."* "The flowers are frequently affected with a species of *Uredo*, insomuch that during one season Mr. Green [of New Bedford, Mass., who seems to have sent Torrey the first specimens of the plant] was unable to find a single specimen that was not diseased."

Fuirena squarrosa Michx. nearly ranks with this group, having one locality north of Detroit, Mich., accorded it, and occurring also in northern Ohio. West it appears again in Nebraska. Last summer it was found in a single locality in the dune region.

These plants generally grow in proximity in the same sloughs, being plants of wet ground, with the exception of *Panicum lanuginosum* which frequents the slopes of neighboring sand hills and comes down to the sloughs at their base. It occurs also in localities outside of the dunes proper. They have been obtained near Dune Park, Porter County, Ind., all but *Scleria Torreyana* in a section of the dune area I had not visited until 1897, and am not aware of its having been explored by others previously.

Some plants from the same section which have had an eastward or a southern range assigned them can be added to the list. *Eleocharis Robbinsii* Oakes, not given farther west than Clinton County in Central Michigan, the only known locality in the State (Beal and Wheeler's Michigan Flora, 1892); *Scleria reticularis* Michx. and *S. pauciflora* Muhl., south of this along our meridian. By finding the last the past season there are given to the dune region five of the six species of *Scleria* within the range of the Manual region, *S. triglomerata* and *S. verticillata* being known from here before and quite general in their occurrence. They can all be obtained in a limited area at Dune Park, together with the plants heretofore mentioned, and within a circle of scarcely more than a mile radius. To this group may be added *Panicum sphaerocarpon* Ell., a plant of dry sand hills; *Linum striatum* Walt., in open wet or wettish ground, both from Dune Park; *Cassia nictitans* L. from the sand hills and ridges of Tolleston, Ind.; and *Aristida gracilis* Ell., from Pine near the lake shore. The latter grows in ground that can hardly be called dry, for it occurs in sand bordering sloughs dry at the time of flowering. Yet one can reach out and get *Utricularia cornuta* and *U. gibba* with one hand while taking the *Aristida* with the other, so that its spring or early summer condition must be quite moist or even wet. *Panicum flexile* and *P. pubescens* are grasses commonly growing with it showing the composite ecological character of the soil conditions often seen in the dune flora, baffling one sometimes to determine whether they are xerophytic or hydrophytic, since they are both at different times of the year. The wettish sands of the spring and early summer provide the seeds of these annual grasses with better means of germination than the drier ridges subject to the wind and where the vegetation is scantier, the ground more bare, so that they grow more abundantly and luxuriantly in ground that becomes dry and suits a xerophytic plant when near its maturity. The westward distribution of *Vitis Labrusca*, which was obtained in the dune region in 1897, was discussed at large in an article in the BULLETIN of the Torrey Botanical Club in October, 1897.

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*Ann. Lyc. N. Y. 3: 361. 1836.

Among the drift hills near Mokena, south of Chicago, two *Carices* occur which have a southern range for this meridian, *C. Shortiana* Dewey, in wet meadows, and *C. triceps* Michx. in oak woods. The latter has a single station given it farther north in the central part of southern Michigan, and both range in Illinois from Peoria south. *Cyperus acuminatus* Torr. and Hook., a sedge with a southwestward extension, was found last year by the Desplaines River at Lockport, Ill. It has been known hitherto in the state as a plant of the valley of the Illinois River and towards the Mississippi. The three are still plants of the Illinois valley for our region as they are beyond the divide which separates the lake region from streams flowing toward the Mississippi.

Some plants with a general northern range or adapted to colder conditions have been added to our flora. *Carex oligosperma* Michx. comes into the dune region from the north, being found in sphagnous swamps and in cranberry marshes at Miller, Ind. The little bitter cress, *Cardamine parviflora* L., was obtained in the oak woods with *Carex triceps* though I have occasionally met with it before. Perhaps there should be added to this northern list *Spiranthes latifolia* Torr., two specimens of which were found by Mrs. Agnes Chase of Chicago, growing on the bogs of springy ground near *Carex Shortiana*. I am not aware of its occurrence elsewhere in this state except in Menard County, a station farther south. In a pond in the same neighborhood an abundance of *Callitriche heterophylla* Pursh was secured, a plant of a wider range, mostly southward, but new to our region. Another rare plant was found twice by Mrs. Chase in the season of 1897, *Ophioglossum vulgatum* L., first in the damp, sandy borders of a slough at Miller, and again in the boggy border of Wolf Lake at Roby, Ind. I have seen it once before during the time of my botanical work, nearly forty years ago in western New York, where I also knew the Adder-tongue Fern in boyhood as a curious plant of the wet meadows. To meet with it twice after so long a time was a rare treat. It had been seen in Illinois so rarely that when Patterson published his "Catalogue of Illinois Plants" in 1876, but a single specimen was reported, obtained by Dr. Schneck in Wabash County.

Some plants have been recently added to our flora which are readily confounded with others that are similar and thus are easily overlooked. *Cyperus Houghtonii* Torr. does not greatly differ from some forms of *C. Schweinitzii* Torr., but is generally a lower plant with a more compact inflorescence, and may also, when the two are neighbors, grow higher up on the sand hills; it is also earlier by nearly a month. It has been in my herbarium since 1881 on the same sheet with its congener, collected in the dune region, but had failed to be separated, perhaps not without cause. In 1878, while studying the flora of Michigan at Petoskey and vicinity, a *Cyperus* was found on the sand hills at Indian River which I identified as *C. Houghtonii* from the description given in Torrey's Cyperaceae, as it was not in the Manual. To be better satisfied some were sent, together with *C. Schweinitzii*, to a well known botanist for verification. They were both pronounced *C. filiculmis* Vahl. This plant has been a familiar one for some time as well as *C. Schweinitzii*. I rested somewhat uneasily under the weight of authority, but finally concluded that *filiculmis* and *Schweinitzii* were different and *Houghtonii* might be a form of the latter, since it was not recognized in our handbooks. The Michigan plant was quite remote from the place where those described by Torrey were obtained, "Lake of the Isles, Northwest Territory," but it has since been reported from the same locality by C. F. Wheeler, as well as from other parts of Michigan. Another of these plants is *Scirpus Smithii* A. Gray, quite closely resembling small forms of *S. debilis* Pursh. Both grow in the muddy borders of sloughs in the sand region, the former as yet seen only at Whiting, Ind. Growing with these, but of wider range, is *Juncus articulatus* L., which may be overlooked on account of its resemblance to *J. Richardsonii* Schult., a very common species here. *J. scirpoides* Lam. may be included with them, in general appearance like some forms of *J. Torreyi* Coville. It is not assigned to the west by Britton and Brown, but I have known it here since 1876 and have since identified it as collected at an earlier date at Kankakee, Ill.

Ledges of rock not being common in our area, plants which require or may seek such a habitat are not expected in much variety. Conditions of this kind exist to some extent along the Desplaines river from Lamont to Joliet, where the Niagara Limestone has been scarped out by glacial action, and low cliffs bordering the flood plain are formed with a talus of rocks at their base. The excavation of the Drainage Canal through this valley, requiring much rock cutting, may in time increase these conditions, for crevices above the waterline will be likely to furnish a foothold for such plants, as the rock faces of unused quarries now do. The most interesting plant of this kind is the little fern, *Pellaea atropurpurea*, which clings in abundance to the face of such a cliff at Lamont. *Silene antirrhina divaricata* Robinson grows with it, its slender sprawling habit making it look quite different from the upright and stiffer form common in dry ground especially by roadsides. I found it the second time the past season growing under somewhat different conditions on bluffs of clay which border a small stream near Thornton, south of this city, but of the same weak, sprawling character, its branches widely spreading. This adds two more stations in Illinois to the one already reported, Rockford. It was also found last season near Peoria. *Pentstemon pubescens* Solander is another denizen of the cliffs as well as of the thin soil spread over the rocks which form the glaciated floor of the river valley. The cliff also furnishes me the only station for a pretty liverwort, *Grimaldia barbifrons* Bisch., its forking thallus forming little patches on the thin soil of crevices. *Polygonum exsertum* Small may be mentioned in this connection, like *Pentstemon pubescens* frequenting the rocky soil of the valley floor both here and at Lockport.

In the field of introduced plants novelties may continually be expected. It is well to note their arrival as nearly as possible, for the migration of plants becomes important in giving some idea of their habits and rate of spreading. As an example the Yellow Cress (*Nasturtium sylvestre*) may be cited. In 1890 it was found near Western Springs, west of Chicago. It had not been reported from our region before and seemed quite local, growing along the wet banks of Salt Creek and by roadsides and in neighboring meadows. Now it is exceedingly abundant along the Desplaines from Riverside to Lamont or beyond. Salt Creek enters the Desplaines near Riverside, and another stream, Flag Creek, heads near Western Springs, but a short distance from Salt Creek, and enters the Desplaines above Lamont. Either route makes an easy path for the spreading of such a plant, but its habits show that it is also provided with other means of migrating. It is a hardy plant and adapts itself to quite a range of conditions: it will grow with its stems half buried in mud and water, and seems equally at home by the roadside where the wagon wheels may bruise it. On railway embankments it spreads beside the rails and even roots in the ballast. Under these dryer conditions it is more branching and bushy, or it may be procumbent, leaning on the ground for support. The railways are in fact responsible for most of our introduced plants as well as their dispersion when once established. Some of these plants are weeds which could well be spared, others are harmless or may be desirable acquisitions.

Coming from the east may be mentioned *Bromus tectorum* L., small and softly hairy, which appears along the railroads east of the city in Indiana. It was first detected in 1897. At the same time *Centaurea Jacea* L. was obtained. *Reseda alba* L. was collected last year in the streets of Morgan Park south of the city. *Artemisia annua* L. was obtained the first time last season from roadsides at Lamont.

But most of our introduced plants came to us from the west or southwest. In 1897 *Agropyron glaucum* R. & S. was found well established in the dry sand at Clarke, Ind. Whether it would prove as troublesome as the real Couch-grass, *A. repens*, of which it is considered a variety by some, remains to be seen should it persist and spread. It was spreading thickly in soil where such grasses as *Stipa spartea*, *Calamagrostis longifolia*, *Eragrostis pectinacea*, *E. Purshii* and *Panicum virgatum* usually grow. Its subterranean stems did not seem as abundant or formidable as those of *A. repens*, but in richer cultivated fields might be different. As the Blue-joint or Blue-stem of the western stockman, highly praised when it is said of it that "no richer hay can be made from anything known," it might have value as a grass for sand dunes. *Helianthus petiolaris* Nutt., of the dry plains of the west, is becoming frequent by railroads both east and west of the city. It is quite ornamental along their roadbeds, blooming when but eight or ten inches high and rarely exceeding a couple of feet. *Allionia linearis* also comes from west of the Mississippi and was taken last summer from street sides at Morgan Park not far from the Rock Island railroad. In a ditch by the same railroad at South Englewood in the city is a patch of *Bidens involucrata* Britton, its large yellow flowers rather handsome. It comes into the western part of Illinois where it may be native, though its range is westward. It was not given in Patterson's catalogue in 1876 and plainly seems to be adventive here. *Coreopsis tinctoria* Nutt was likewise found in street-side lawns and parkways at Morgan Park, perhaps an escape from gardens, though it may have come by the same route as the *Allionia*, being indigenous to the same region. *Plantago aristata* Michx., a low plant with long, stout and prominent spikes, which are rather abundant, appears in the stiff blue clay taken out of the Drainage Canal and on railway embankments near by. It was doubtless discovered more than a century ago by Michaux "in *pratensibus Illinoensium*," in the autumn of 1795, when he travelled in the southern part of the state, though he makes no mention of the discovery in his journal. Dr. Mead reported it from the vicinity of Quincy, farther north than Michaux came. It is interesting to find that it has migrated to the neighborhood of this city, flourishing under somewhat different conditions from those in prairies and meadows. *Aristida oligantha* Michx. was collected in the same place, a grass with about the same range in this state as the *Plantago aristata*. *Sporobolus neglectus* Nash appears like an introduced grass. I met with it first in 1895 by the Wabash railroad in Will county and again the past season at Lake Zurich, Lake county, where it grows by roadsides with *Panicum proliferum* and *Sporobolus vaginaeflorus*, a frequent grass in dry grounds and waste places where it generally grows in dense patches. Both of them have a different habit when growing by roadsides or in places where they are not crowded, forming stools with the much stouter stems semi-prostrate or ascending. *Panicum proliferum* has a similar habit, becoming a good sized weed in dry grounds, though smaller than in its native swamps or wet lands. The three seem well adapted to endure the wear and trampling to which such plants as grow by highways are more or less subjected.

New and interesting Plants from Western North America.—V

By A. A. Heller

Lepidium Idahoense sp. nov.

Apparently annual; stem 20–50 cm. high, smooth to the naked eye, but sparingly puberulent under a lense, somewhat shining, purplish below, much branched above, forming a corymbose top: basal leaves not seen; lower cauline obovate-oblong, about 6 cm. long, on margined petioles of 2 cm., laciniately dentate, the divisions ascending, sparingly covered on the margins and veins with whitish, curved bristles; upper cauline short-petioled or sessile, entire or nearly so, and finally reduced to linear bracts: inflorescence glabrous; pedicels slender, divaricate, or somewhat ascending, 4 mm. long; petals white, prominent, obovate cuneiform, slender clawed, about 2 mm. long; pods nearly orbicular, glabrous, 2 mm. or slightly more in diameter, notched; style very short, stout.

Our no. 3044, collected on the right bank of the Snake River, near Lewiston, Nez Perces County, Idaho, May 11, 1896, altitude about 800 feet. Later older and taller specimens were collected in gravelly ground along Hatwai creek, six miles east of Lewiston. The type is in my private herbarium.

To *Lepidium Idahoense* belongs no. 145 of Sandberg, MacDougal and Heller, collected along the Clearwater river, about eight miles east of Lewiston, in May, 1892. Their specimens were referred by Mr. Holzinger to *Lepidium alyssoides* A. Gray, a species with which it has no particular affinity.

Lepidium simile sp. nov.

Annual; stem 30–35 cm. high, strongly puberulent below, less so above, corymbosely branched above, basal leaves 3–4 cm. long, obovate-oblong, pinnately lobed or parted in the lower half, the upper almost entire, bluntish, puberulent; lower cauline leaves much like the basal but narrower and more acute; upper cauline entire or nearly so, lanceolate or linear lanceolate: inflorescence puberulent; pedicels slender, 3 mm. long, ascending; petals greenish-white, inconspicuous, spatulate, about 1 mm. long: pods about 2 mm. wide, a little longer than broad, slightly notched, puberulent, especially on the margins; stigma sessile or nearly so.

Our no. 3044a, collected on the right bank of the Snake River, near Lewiston, Nez Perces county, Idaho, May 11, 1896, altitude about 800 feet. This species was associated with *Lepidium Idahoense*, which it resembles in manner of growth and appearance of herbage. The principal differences are found in the inflorescence, as will be seen by comparing the two descriptions. *L. simile* is also less inclined to branch, and the branches ascending at an acuter angle. The type is in my private herbarium.

Ptelea rhombifolia sp. nov.

A shrub, about 2.5 meters high, branching above, the branches spreading, light brown, or grayish, the older ones usually smooth, those of the season's growth pubescent with short curved hairs; leaves trifoliolate, the petioles and lower surfaces covered with tomentose hairs, the upper surfaces also pubescent, but less so, and greener; petioles about 5 cm. long; leaflets somewhat rhombic ovate, or rhombic orbicular, the largest about 5 cm. long, and 4 cm. wide, their apices either rounded or slightly pointed, midrib yellowish, prominent, as are also the pinnate veins: inflorescence strongly pubescent, including the petals and the bases of the stamens; petals creamy white, obovate-oblong, about 4 mm. long; samara almost orbicular, about 1.4 cm. in diameter, reticulate.

My no. 1582, collected at San Antonio, Bexar county, Texas, April 27, 1894, altitude 600 feet. The specimens were collected in a wooded tract lying between the right bank of the river and the Southern Pacific railroad track. Specimens were distributed under the name "*Ptelea trifoliata mollis*," but can hardly be referred to that species, which has a more eastern distribution. The type is in my private herbarium.

To *Ptelea rhombifolia* I would also refer Dr. D. T. MacDougal's no. 139, collected in Walnut Cañon, near Flagstaff, Arizona, June 18, 1898.

Microsteris diffusa sp. nov.

Diffusely branched from the base, 15–25 cm. high, often 30 cm. broad, pubescent throughout with chaffy, spreading or twisted hairs, those on the upper portion of the plant glandular: leaves all sessile, the lowest ones oblong-oval, nearly glabrous, the others lanceolate, acute, usually about 4 cm. long, and from 5 mm. to 1 cm. wide; flowers rather numerous; calyx 1 cm. long, the tubular portion united by a membrane, the lobes about 1 mm. wide at the base, gradually attenuate to the mucronate apex, erect in anthesis, spreading, and more or less recurved at maturity; corolla pale violet, the slender tube barely the length of the calyx, the lobes very small: seeds straw-color.

Our no. 3098, collected near the mouth of the Potlatch river, Nez Perces county, Idaho, May 20, 1896, altitude about 1200 feet. The plants grew in rich, stony basalt formation in a thinly wooded tract on the right bank of a small stream which empties into the Potlatch just above the junction of that stream with the Clearwater.

Our specimens were distributed either as "*Phlox gracilis*" or *Collomia gracilis*, and are near to that species in most particulars. The corolla lobes, however, are much smaller, the sepals broader at the base, and the seeds straw-color, instead of light brown, and it is of totally different habit, being more like *Microsteris humilis* in that respect. The type is in my private herbarium.

CASTILLEJA LUTEA Heller, Bull. Torr. Bot. Club, **25**: 268. 1898

In describing this species, I referred to its possible relationship with *C. desertorum* Geyer, and through oversight in reading Hooker's reference to this name, made the following inexcusable statement: "As he gives no description whatever, and does not even mention the color, which is said to be the sole difference, the name is *nomen nudum*, and we have no other clue than that of locality." The color is mentioned, however, for the bracts are described as yellow and scarlet variegated. I have now no doubt as to the distinctness of my species. In the herbarium of Columbia University there is now a single specimen besides my own *C. lutea* collected by Professor C. V. Piper of Pullman, Wash.

Crepis atrabarba sp. nov.

Perennial from an ascending rootstock; stems 4–5 dm. high, rather stout, covered with more or less deciduous wool, especially below, branched above: basal leaves lanceolate, about 20 cm. long, including the margined petiole, which is 5–6 cm. long, lower part of blade 5–6 cm. wide, deeply pinnately lobed or runcinately toothed, the divisions lanceolate or linear-lanceolate, some of them bearing slender teeth, the upper part of the blade forming a slender, linear-lanceolate, acuminate tip, 5–6 cm. long; cauline leaves usually of the same shape as the basal, but short-petioled, or the uppermost reduced to linear bracts: anthodia about ten, fastigiately corymbose: involucre 10–14 mm. long, wooly, the divisions linear, green whitish margins, costa not prominent, clothed with spreading, minutely glandular, black bristles; corollas evenly notched with five very short, blunt teeth; immature achenes light brown, apparently of almost even width; pappus longer than the achenes.

Our no. 3302, collected on the slope below Lake Waha, Nez Perces County, Idaho, June 22, 1896, altitude about 1800 feet. The plants were growing in rich, stony, basalt formation. In shape and cut of leaf, this species resembles *C. barbigera* Leiberg, but in no other respect. The type is in my private herbarium.

Grindelia Brownii sp. nov.

Perennial; stems clustered from a stout, ligneous root, 35–60 cm. high, slightly chaffy, red or purplish, branching above, leafy throughout: leaves sessile, spatulate-lanceolate, acute, the lower about 5 cm. long, and little more than 1 cm. wide at the widest part, serrate with spreading teeth; upper shorter and narrower in proportion, and often entire: heads 1 cm. high, and little broader; bracts of the involucre lanceolate or linear, the outer shorter and narrower, recurved; achenes short, obovate, truncate, several ribbed, two of these wing-like; pappus of two awns.

Our no. 3418, collected on the "breaks" of the Salmon River, near the mouth of Maloney Creek (about Forest on labels), Nez Perces County, Idaho, July 14, 1896, altitude about 2000 feet. The plants were growing on a precipitous grassy slope, in granite formation. Specimens were, perhaps, distributed without specific name, or as *Grindelia squarrosa*, under which species it can hardly be placed.

Named in honor of Mr. H. E. Brown, who acted as guide during the day on which the species was collected, and greatly assisted my wife and myself in our work. The type is in my private herbarium.

411 WEST WALNUT STREET, LANCASTER, PA.

Two new Polypodia from New Zealand

By Benjamin D. Gilbert

When the Transit-of-Venus expedition was sent to New Zealand, in 1874, the party landed at Dunedin, on the southeast coast of the middle island. But the fogs of that part of the island obscured the sky too much to suit an astronomer and after investigation it was decided to go inland about 100 miles to a place called Queenstown, on or near Waikatipu Lake, where the land was much higher and fogs did not exist.

Dr. C. H. F. Peters, who was the astronomer-in-chief, had promised me before leaving home that he would procure for me such ferns as he might be able to find. While his temporary observatory was being built he took many walks about the adjacent country; and during these rambles he picked up a considerable number of species that were really desirable. Among the *Lomarias* that abound there he secured *L. vulcanica*, *L. alpina*, *L. fluviatilis*, *L. Fraseri* and, of course, *L. procera*, and one of its most interesting varieties, *L. imbricata*. He brought two fine species of the beautiful *Todea* as well as endemic species of *Cyathea*, *Hymenophyllum*, *Trichomanes*, *Gleichenia*, *Dryopteris* and *Polypodium*. In this last genus there were specimens of a fern which Dr. Hooker does not give in his Flora of New Zealand and which has seldom been found in the southern hemisphere, viz., *Polypodium vulgare*. There is enough peculiarity about it to constitute a distinct variety, but if all the forms from different parts of the world that have been placed under this species really belong there, then this form also must be included.

There was also another Polypod allied to this, but so distinct that, after having it under occasional observation for 25 years, I have decided to describe it as an entirely new species. The description is as follows:

Polypodium viride sp. nov.

Rhizome the size of small whip cord, the growing end densely clothed with bright brown narrow-lanceolate scales, their filiform apices often twisted: stipules slender, close together but hardly clustered, ¾ to 1¼ in. long, greenish or greenish-brown, naked, slightly margined at base: mature fronds 1¾ to 2½ in. long, ¾ to 1 in. wide, pinnate with a yellowish pellucid callosity in the sinus between pinnae: color bright green on upper side, paler beneath, rachis green with a few minute scattered scales as in *P. Plumula:* largest pinnae ½ in. long, strictly alternate, 8 to 9 pairs with a similar terminal pinna that is slightly pinnatifid below lower pinnae not reduced, each pinna expanded at base on both sides and adherent: veins free, *only once forked* semi-pellucid, clavate within the margin: sori in two rows, 4 to 6 on each side of costa and extending on to terminal pinna, chiefly on upper half of frond, large, borne at extremity of anterior branch of veins midway between costa and margin, but filling the entire width of pinna, papillose on upper side of frond: texture firm, subcoriaceous.

This beautiful little fern is intermediate between *P. pellucidum* and *P. vulgare.* It differs from its two allies in its smaller size, in having the veins only once forked like those of a *Cyathea,* in the fine black wavy costae, in the slender green stipes and rachis and in the metallic green color of its fronds. Although it is 25 years since it was gathered, it retains its greenness as brilliant as ever.

Polypodium vulgare auritum var. nov.

General features and venation same as in species: texture very thick and opaque, but veins raised enough to show venation: cut down close to rachis and lowest pair of pinnae fully separated: texture so thick that surface is corrugated and pitted on upper side, especially the ends of veinlets: edges of pinnae wavy: stipites very thick and stout but stramineous as in typical *P. vulgare,* lowest pair of pinnae generally auricled at base on lower side only, the auricle being sometimes one-third the length of pinna. These auricles are not always present even on fronds from the same rootstock, but they seem to be the rule and give a definite character to the variety. Our eastern *P. vulgare* stands midway between this and the thin sharp pointed form that grows in Japan and is known as var. *Japonicum.*

Acrostichum lomarioides Jenman*

BY GEORGE E. DAVENPORT

Attention having been called to this new species through Mr. Gilbert's recent revision of the Bermuda Ferns in the BULLETIN of the Torrey Botanical Club for December, 1898, and Jenman having credited it to Florida, I venture to offer some comments upon it.

A. lomarioides is described in the Synoptical List of Jamaica Ferns, being published by G. S. Jenman in the Bulletin of the Botanical Department of Jamaica, and is said by him to have long been confused with *A. aureum* L., from which species he now separates it as distinct.

The basis for this separation rests primarily upon the following differences as described by Jenman himself—the greater size of the new fern, a greater difference in the relative size of the fertile and sterile fronds; the uniformly separate barren and fertile fronds—all the pinnae of the one being barren, and all of the other fertile; the much more sessile leaflets (turned transversely with the rachis, the plane to the sky like the blades of a step ladder); the intestiniform translucent, pale colored corpuscles covering the sporangia, which give a pale pruinose color to the soriferous under surfaces, and, according to Gilbert, a difference in the meshes of the venation, and the direction of the areoles.

None of these characters, however, seem to me to have specific value, and the greater number of them are more or less unimportant, as they constitute only such varying characters of a secondary nature as are found in a great many other ferns.

The force of Jenman's statement that the new fern is greater in size than the old one is neutralized by his own descriptions, which give the fronds of *A. aureum* as being "2 to 4 ft. tall, 1 to 1½ ft. wide"; and those of *A. lomarioides* as being only "2 to 4 ft. tall, but 1½ to 2 ft. wide," a difference in the breadth only, surely a character of no consequence whatever.

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* Read before the New England Botanical Club, March 3, 1899.

Mr. Gilbert describes his Bermuda plants as "being magnificent in size, reaching far above the head of any man, sometimes to the height of eight or nine feet." But J. Donnell Smith found plants of *A. aureum* in Florida growing to the height of eleven feet.

Pteris aquilina ordinarily averages from two to four feet in height, yet in Florida it has been known to reach the height of twelve and fourteen feet.

As for the uniformly fertile and sterile fronds, here again the force of Jenman's description of "all the pinnae of the one being barren, and all of the other fertile," is neutralized by his unfortunate citation of Professor Eaton's figure in Ferns of North America **2**: *pl. 58*, for an illustration, as that figure does not represent a frond with all of the pinnae fertile, but one with only the upper half fertile, as in normal *A. aureum.*

I do not wish to be understood as calling in question the validity of Jenman's species so far as it relates to his Jamaica plants, which I have not seen, and if there should exist a form there with uniformly dimorphous fronds in the same sense as we have them in *Onoclea, Osmunda,* and some other genera—with the tissue of the lamina transformed into sporangiferous receptacles, as, for example, in *Acrostichum* (*Polybotrya*) *apiifolium*—it would be entitled to recognition, but no such fern has as yet been recorded from Florida.

Contribution to a Knowledge of the Myxogasters of Maine.—III

By F. L. Harvey

Since my last article on the Myxogasters of Maine in this journal, February, 1897, specimens have been collected by Mr. E. D. Merrill, my assistant, and myself, which extend considerably the list of Maine species. They are recorded below together with new localities for species reported in previous contributions. Monmouth, where Mr. Merrill's specimens were taken, is on a tributary of Lake Cobbosseccontee, the location of one of the fish hatcheries of Maine. We have followed Lister in the order of presentation so far as possible. Numbers above 115 are accessions to the State list. Those below refer to species mentioned in previous articles. We are under obligations to Mr. A. P. Morgan, who has kindly given his opinion on specimens submitted to him.

116. *Physarum leucopus* Link.

Monmouth, July, 1897 (E. D. Merrill). This species is rare in America. Lister in his Mycetozoa gives Ohio as the only American locality. To find it so far east is interesting. The plasmodia were small but typical. Found on grass and blackberry leaves on the ground.

117. *P. citrinum* Schum.

Oldtown, 1898. Growing on a charred log at Kukunsook landing, Pushaw Lake (Harvey). Specimens in fine development. This is *Cytidium citrinum* Morgan. (Myx. M. V.)

118. *P. tenerum* Rex.

Orono, Me., 1898 (Harvey). This is the *P. obrasseum* B. & C. of Morgan's papers (Myx. M. V.). Specimens scanty and poor.

119. *P. compactum* Lister.

Birch log on moss, Oldtown, Me., August, 1898 (Harvey). This was found in woods on the border of Pushaw Lake at the Kukunsook landing. This is *Tilmadoche compactum* Wingate.

120. *P. psittacinum* Ditmar.

Monmouth, July, 1897 (Merrill). This is *Leocarpus psittacinum* in Morgan's Myx. M. V. Our specimens are fine.

121. *P. viride* Pers. var. *aurantiacum*.

On decaying pine logs, Orono, 1897 (Harvey). This is *Physarum aureum* Pers. On weathering, this form loses its orange color and then cannot be distinguished from *P. nutans*, the stalks of both species being always alike.

122. *P. albipes* Link.

Orono, 1897 (Harvey). We sent a specimen to Mr. Morgan who says: "Rostafinski included this species in *Tilmadoche nutans*. The stipe is long as in *Physarum nutans*, but the base is not umbilicate." The capillitium is like that of *P. leucophaeum* Fr. and I should prefer to label your specimen as you have it rather than *P. nutans* Pers.

123. *P. leucophaeum violaceus* Rost.

Orono, 1896 (Harvey). Mr. Morgan says: "Your specimen is very beautiful; sporangia almost destitute of lime and scarcely any in the capillitium. It is Rostafinski's var. *violaceus*. You seem to have all the forms of this species in Maine."

124. *P. Columbinum obovatum* A. & S.

Orono, Me., 1896 (Harvey). Mr. Morgan made the following note on specimens sent him: "This is a puzzle. Lister would promptly refer it to *Lamproderma physarioides* A. & S., but it is not what I understand to be that species, which is perfectly globose and has a silvery sheen. I should call it *Physarum Columbinum obovatum* in the Conspectus of A. & S."

11. *P. sinuosum* Fr.

Monmouth, Me., July, 1897 (Merrill). In fine development. This is *P. bivalve* Pers. in Lister's Monograph.

17. *Fuligo rufa* Pers.

Monmouth, Me., July, 1897 (Merrill). These specimens have a grayish fragile cortex and appear different from ordinary forms of *Fuligo septica*. Mr. Morgan named the specimens and we do not know whether the *F. rufa* of his writings is regarded by him as different from *F. septica*. If the same, it has been reported from Maine, no. 17. If not, it should be added.

20. *Chondrioderma testaceum* (Rost.) Versuch.

Monmouth, Me., July, 1897 (Merrill). A single small specimen.

125. *Chondrioderma reticulatum* Rost.

Monmouth, Me., July, 1897 (Merrill). Abundant on fallen leaves.

23. *Diachea elegans* Fries.

Monmouth, Me., July, 1897. Mr. Morgan calls this *D. leucopoda* Rost. Cooke and Lister referred it to the above.

34. *Stemonitis microspora* Lister.

Monmouth, Me., July, 1897 (Merrill). This is *S. ferruginea* Ehr. but not of Fries. An abundant species in Maine maturing early.

37. *Comatriche aequalis* Peck.

Oldtown, Pushaw Lake. Abundant in August on charred logs (Harvey). Lister includes this under *C. obtusata*. Mr. Morgan thinks it rather resembles *S. typhoides* Rost. If *S. obtusata*, then it was reported as no. 37.

126. *Lamproderma arcyrionema* Rost.

Orono, Me., 1897 (Harvey). On rotten wood. Mr. Morgan says regarding my specimens, "I have no doubt this is *Stemonitis obtusata* Fr. S. M. and I am surer yet that it is *Stemonitis reticulata* Trentepohl.

127. *Lindbladia effusa simplex* Rex.

Orono, 1897 (Harvey). Monmouth, July, 1897. Mr. Merrill's specimen was nearly three inches across. The Orono specimen less than an inch. This is Peck's *Licea caespitosa* = Morgan's *Tubulina caespitosa*. The plasmodium of this is olive black.

128. *Cribraria argillacea* Pers.

Monmouth, Me., July, 1897 (Merrill). Growing in moss on the ground.

129. *C. aurantiaca* Schrader.

Bradley, Me., 1898 (Harvey). On rotten wood. Our specimens are *C. vulgaris* Schrad., which Lister refers to the above.

130. *Arcyria irregularis* Racib.

Orono, Me., 1896 (Harvey). Mr. Morgan says "these specimens puzzled me greatly. It is possible I have overlooked it in previous specimens, confounding it with *Hemiarcyria stipata* Schw. This I am confident Lister has done, which accounts for his *A. stipata.* There is the appearance of something abnormal about it, but the capillitium and spores appear all right. I can see no spirals on the threads; they are thickly set with prominences or blunt spines in some places. The threads do not appear to be attached to the wall but arise out of the stipe. I think it is an *Arcyria.* I cannot refer it to *Hemiarcyria stipata* Schw. though superficially it looks like it. *A. irregularis* Racib. describes it very well."

Arcyria minor Schw.

An abundant species in Maine was always referred to *A. incarnata* Pers. by Dr. Rex. Mr. Morgan thinks *A. affinis* Rost. the same thing, and that is the same as *A. vermicularis* Schum. an older name that should be restored.

131. *Lycogala repletum* Morgan.

Pea Cove, October, 1898, (Harvey). A single cluster of several specimens varying in size from a half inch to an inch and a half. Growing on a live elm about a foot from the ground in the edge of a hollow in the tree. This is a larger species than *L. plavo-fuscum* and the tubules are branches of broad flat membranes, instead of cylindrical outgrowths directly from the walls. The type specimens were collected by Mr. Parish in California. It is remarkable to find the species so far east.

Mr. Morgan says that "I am disposed to think this form equal to *Lycogala testaceum* (Wallr.), described in Flora Germanica." This is referred to *Lycogala flavo-fuscum* in Saccardo, but is probably distinct.

132. *Fuligo laevis* Pers. Pea Cove, Oct. 1898, F. L. Harvey.

A specimen sent Mr. Morgan was named as above. There is great confusion in this group, several apparently distinct forms being referred to *Fuligo varians.* Mr. Morgan says of our specimens, "I have a specimen just like yours from Iowa, collected by McBride. The sporangial walls are greatly developed and persistent, the capillitium extremely scanty, the bladder-like vesicles being about all there is of it."

Remarks: We collected *Arcyria punicea* and *Physarum leucophaeum* on Mt. Ktaadn, in September, 1898, the former in the south basin at an altitude of 2,500 feet, and the latter on the edge of the plateau 3,500 feet. The sporangia of the latter were dwarfed. At Foxcroft we found *Ceratiomyxa mucida* in fine development.

A Bryological Memorial Meeting at Columbus, Ohio.

Columbus was the home for many years of William S. Sullivant and Leo Lesquereux, two names which will always awaken love and reverence from all students of North American mosses and hepatics. It is twenty-six years since Sullivant died, and this last quarter of the century has seen a marked extension of the limits of bryological study and a large increase in the number of students. It seems a fitting time and place to take a survey of the field, review the past and make plans for the future, hence it is proposed to make the coming meeting of the American Association for the Advancement of Science, which is to be held at Columbus, the occasion for a Memorial Day in honor of the Nestors in American Byrology and to call on all botanists and botanical journals to help make the occasion a memorable success. It is proposed to present a series of papers, illustrated by photographs, specimens and microscopical exhibits under the following topics: Historical papers and collections illustrating the bryological work of Hedwig, Palisot de Beauvois, Michaux, Muhlenberg, Bridel, Torrey, Drummond, Hooker and Wilson, Greville, Sullivant and Lesquereux, James and Watson, Austin, Ravenel, Wolle, Bolander, Eaton and Faxon, and Müller. Supplementing these there will be shown collections of specimens, macroscopic and microscopic, illustrating the monographic work of recent American students.

If foreign students who have worked on North American byrophytes can be persuaded to coöperate with us, the following will be asked to contribute: Bescherelle, Brotherus, Cardot, Dixon, Kindberg, Mitten, Pearson, Röll, Stephani, and Warnstorf.

An effort will be made to secure the loan of type specimens and illustrations from the following sources: Academy of Natural Sciences of Philadelphia, Academy of Sciences of New York, Columbia University, Geological and Natural History Survey of Canada, Harvard University, National Museum, Ohio State University, University of Wisconsin, and Yale University, as well as from private herbaria and collections. It is also requested that any portraits, autograph letters and type specimens and drawings of special interest be loaned for the occasion, as well as presentation copies of books and pamphlets.

The following committee of organization will gladly answer any questions and give assistance to those wishing to contribute:

Mrs. N. L. Britton, New York Botanical Garden.
Professor W. A. Kellerman, Ohio State University.
Dr. George G. Kennedy, Readville, Mass.
Professor Charles R. Barnes, University of Chicago.
Professor Lucien M. Underwood, Columbia University.

Proceedings of the Club

December 13, 1898.*

Vice-President Allen in the chair, thirty-five persons present.

Three new members were elected; two new nominations for membership were made: Mrs. Horace See, 50 W. 9th Street, and Ex-Chief Justice Charles P. Daly.

The paper of the evening was by Miss Marie L. Sanial on Nature Study in the Public Schools. The following is an abstract:

"The introduction of nature study in the lower grades of the public school is a new departure in elementary education. Of course, it is not intended to teach natural history as a science to children of a tender age. The purpose in view is simply to draw from nature certain object lessons calculated to aid in the orderly development of the perceptive and reasoning faculties. The method of instruction should rest upon two fundamental principles fully established by the observed facts of psychology. One is the fascinating power of visible motion upon the child's mind. The second, intimately connected with the first, is the natural process of mental development. This process, consisting as it does in observation and comparison, is essentially analytical and is, therefore, the very reverse of the constructive or synthetical process of nature herself. While nature proceeds in her work from the low and apparently motionless forms to gradually higher ones gifted with increasing powers of displacement, the human mind proceeds in its observation from the highest and most active to the lowest and most passive. The first object lesson should, therefore, be taken from the animal world and from those plants which, by their bright colors, rapid development and other striking features, are most suggestive of motion. If her material be taken from the vegetable world, for instance, the teacher should make such use of it or devise such artifices as will enable the pupils to see, follow and observe "the plant in action," so that their interest may steadily increase as they successively and spontaneously discover that the apparently lifeless thing before them actually feeds, drinks and breathes, grows and moves, feels and acts, likes and dislikes, enjoys and suffers, lives and dies.

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* Omitted by mistake from its proper sequence in the last number.

"In the examination of parts the following order, when practicable, will best conform with our fundamental principles: 1. The fruit; 2. The flower; both presenting qualities of color, form, taste and smell, which, together or singly, first commend them to the child's attention on the threshold of plant life investigation; qualities which correspond in some respect to the phenomena of visible motion in animal life.

"Descending by degrees from these upper and last products of vegetable development, will be observed in succession, the leaf, the stem and last the root.

"In other words we must begin with facts of a primary order, tending to develop attention, perception and observation. These first facts, simple and detached, apparently unrelated, will of themselves lead to the observation of other facts, more complex, more and more intertwined and at last obviously related; that is, facts of a higher order, tending to the exercise of judgment by comparison and consequent classification. When we shall have reached this point, our minds will be ready for the discovery, by induction, of still higher facts, imperceptible to our senses without the powerful aid of human reason, fully developed; we shall be ready for generalization. The whole philosophy of nature study—and we may say the whole philosophy of teaching—lies in the observance of this order.

"It is essentially the work of the teacher, who has reached the point of developed reason, to classify her facts, so that her pupils may without feeling her hand or her influence, be made to look for just such facts as are suited to their own intellectual stage. Not so much on the variety or brilliancy of her illustrations, as upon the natural, logical order in which she will imperceptibly compel their observation of facts will depend her success."

Miss Sanial added also an account of her experience as supervisor of nature study in the vacation schools of New York City, and indicated the difficulty at present confronting the subject on account of lack of provision for supply of material.

Miss Sanial's paper was followed by an extended discussion of the needs of further provision for nature study in the public schools, participated in by Mr. Hyatt, Mr. Wade, Mr. Conroy, Mrs. Britton, the secretary and others, and followed by the adoption of the following resolution offered by Dr. Britton :

Resolved, That a committee of five members be appointed by the chair to prepare a presentation of the desirability of a systematic supply of nature study material to the public schools for submittal to the President of the Board of Education after approval by the club.

Miss Sanial exhibited an interesting series of mounts and cards showing the admirable work done in nature study in the vacation schools.

A large collection of photographs of wild flowers was exhibited by Mrs. Britton, displayed upon the wall facing the club. These photographs, the work of Mr. Henry Trott, of Philadelphia, are excellent for school or other illustrations. Mrs. Britton also commented upon the good beginnings made in New York and Brooklyn in hanging nature pictures in schools.

WEDNESDAY EVENING, MARCH 29, 1899.

Meeting held in the large hall of the College of Pharmacy.

Dr. Rusby in the chair. 60 present.

Four new members were elected : Hr. W. H. Lewis, Jr., 11 East 35th Street, nominated by Dr. H. H. Rusby ; Miss Marion Shutes, 168 West 120th street, nominated by Miss Marie L. Sanial ; Miss Elizabeth Anne Jacobs (Public School 117), 117 E. 82d Street ; Miss Nellie Geraty (Public School 96), 39 E. 76th Street.

Dr. Britton reported as chairman of committee on nature study, that finding it impracticable to get the members of the committee together to call on the President of the Board of Education, he had transmitted the committee's report to President Little by mail. The report of the committee was accepted and the committee discharged.

The first paper was by Professor Francis E. Lloyd, on the Functions of the Suspensor, and was illustrated by drawings and by a series of microscopes exhibiting slides.

Mr. Lloyd described the structure of the suspensor typical of the genera *Galium*, *Asperula*, *Vaillantia*, etc., and showed that haustoria are formed which absorb food from the endosperm. The large basal cell of *Capsella* was shown also to possess a function quite similar, because, as the preparations showed, the basal cell destroys the tissue of the inner integument in its vicinity and thus becomes embedded in it.

The second paper was by Mrs. E. G. Britton, on the Ferns of the Eastern United States, illustrated by the stereopticon.

Mrs. Britton exhibited mounted specimens of all the rarer ferns of the Eastern States, many of them of her own collection, giving the range of each species. She also exhibited lantern slides made from photographs of these ferns taken as they grow. Those of the maiden-hair, hart's tongue and beech-fern were taken from the fernery in the New York Botanical Garden ; five of them were views from the Catskill Mountains taken by Mr. Van Brunt; Mr. Hulst contributed one from Lake George, and Mr. Lorenz five from Willoughby Lake, Vermont. Others were Adirondack views taken by Stoddard. Mrs. Britton stated that she would continue to fill in the omissions where she had not been able to obtain photographs, and hoped to complete her collection in the future. She expressed the hope that as the interest in ferns increases the love of them would likewise grow, and that the rarer ones would not be exterminated by useless transplanting to locations where they will not survive. It was stated that thus far Rutland County, Vermont, shows the greatest number of ferns of any of the Eastern States, having 42 species and ten varieties. There are seldom more than 20 species in any locality, unless there should be a great variety of soil and habitat as at Jamesville, N. Y., where Prof. Underwood has found 34 species. Long Island has 25, and Staten Island 23 species.

In further illustration, the Torrey Club collection of ferns and many sheets from the Columbia collection, were exhibited, and a series of photographs from Professor Atkinson, showing the variations produced by cultivation of *Onoclea sensibilis*.

An exhibit to illustrate *Onoclea sensibilis* in the fossil state was also furnished by Dr. Hollick, the same being of special interest as the only living species which is actually found fossil.

Mr. Wm. A. Lorenz, of Hartford, Conn., was introduced by Dr. Rusby as one who had collected 34 species of ferns about Willoughby Lake, Vermont. Mr. Lorenz described the lake and neighboring cliffs with the illustration of lantern slides, and spoke of the hundreds of plants of *Woodsia glabella* flourishing there close together, fruiting at 1 inch or at 6 inches. In the sunshine it becomes more leathery as if passing into *W. hyperborea.* Mr. Lorenz also finds *Dryopteris spinulosa dilatata* reverting there to the type of the species.

Mr. W. N. Clute exhibited several fronds of *Dryopteris simulata*, collected by him at Babylon, L. I., last summer, and pointed out a distinction from *D. Thelypteris* in the fact that each pinna of *D. simulata* is not of uniform breadth but broader near the middle; it fruits chiefly in the shade, and *D. Thelypteris* in the sun.

Dr. Rusby spoke of the beauty of the ferns on the mountain slopes near Plainfield, N. J., and at localities near there for *Asplenium ebenoides*, *Cystopteris fragilis*, and *Cheilanthes lanosa.*

Mr. Clute remarked that he had collected 16 species of ferns within a mile of Fort Lee, and 59 species are now growing at the Botanical Garden.

Adjournment followed.

EDWARD S. BURGESS,
Secretary.

Index to recent Literature relating to American Botany.

Baker, J. G. *Yucca elata.* Curt. Bot. Mag. **55**: *pl. 765.* Ap. 1899.

Bessey, E. Another station for *Thorea ramosissima.* Bot. Gaz. **27**: 71. 1899.

Bigelow, C. E. A trip to Mt. Mansfield in June. Plant World, **2**: 105–107. Ap. 1899.

Britton, N. L. Report of Director-in-Chief of the New York Botanical Garden for 1898. Bull. N. Y. Bot. Garden, **1**: 171–242. 13 Ap. 1899.

Contains among other matter a list of plants growing in Bronx Park.

Britton, N. L. Description of a new Stonecrop from Mexico. Bull. N. Y. Bot. Garden, **1**: 257. 13 Ap. 1899.

Sedum Mexicanum sp. nov.

Britton, E. G. Fossil Mosses. Plant World, **2**: 108, 109. Ap. 1899.

Caldwell, O. W. On the Life History of *Lemna minor.* Bot. Gaz. **27**: 37–66. *f. 1–59.* J. 1899.

Campbell, D. H. Vacation Notes. I. Notes on the Flora of California. II. The Northern Pacific Coast. Am. Nat. **33**: 299–311; 391–401. Ap. My. 1899.

Canby, W. M. A new *Silphium.* Bot. Gaz. **27**: 139, 140. F. 1899.

Clute, W. N. The Making of an Herbarium. Plant World, **2**: 111–113. Ap. 1899.

Clute, W. N. The Making of an Herbarium. Mounting. Plant World, **2**: 131–133. My. 1899.

Cook, O. F. Four Categories of Species. Am. Nat. **33**: 287–297. Ap. 1899.

Cowles, H. C. Geographical Relations of the Dune Floras. Bot. Gaz. **27**: 95–117. *f. 1–26.* F. 1899.

Dietel, P. & Neger, F. W. Uredinaceae chilenses III. Engler Bot. Jahrb. **27**: 1–16. 7 Ap. 1899.

Duggar, B. M. Notes on the maximum thermal Death-Point of *Sporotrichum globuliferum.* Bot. Gaz. **27**: 131–136. F. 1899.

Fitzpatrick, T. J. & M. F. L. *Asclepias Meadii* Torrey. Plant World, **8**: 107. Ap. 1899.

Goetz, G. Ueber die Entwickelung der Eiknopse bei den Characeen. Bot. Zeit. 57^1: 1–13. *Pl. 1.* F. 1899.

Greene, E. L. Neglected generic Types, I. Pittonia, **4**: 45–51. 11 Ap. 1899.

Phyla, Sieversia, Vanclevia adopted with transfer of species.

Greene, E. L. Two new *Gerardias.* Pittonia, **4**: 51–52, *pl. 9, 10.* 11 Ap. 1899.

G. decemloba and *G. Holmiana* sp. nov.

Greene, E. L. New or noteworthy Species, XXIV. Pittonia, **4**: 35–45. 17 Mr. 1899.

New species in *Ribes, Arnica, Agoseris, Lactuca, Campanula, Pyrola, Phacelia, Antennaria, Chrysothamnus, Grindelia, Hymenopappus,* and *Silphium.*

Griffiths, D. The Blights or Powdery Mildews. Asa Gray Bull. **7**: 25–30. *pl. 3.* Ap. 1899.

Grout, A. J. A Botanist's Day on Mt. Washington. Plant World, **2**: 116–118. Ap. 1899.

Halsted, B. D. Relative Rate of Growth of Peas and Beans. Asa Gray Bull. **7**: 38. Ap. 1899.

Halsted, B. D. A Experiment with Sex in Hemp Plants. Plant World, **2**: 110. Ap. 1899.

Halsted, B. D. What are the Habitats of *Scutellaria parvula* of Michaux? Plant World, **2**: 128. Mr. 1899.

Hemsley, W. B. *Hevea similis.* Hook. Ic. Pl. **26**: *pl. 2576.* Mr. 1899.

A native of Brazil.

Hemsley, W. B. *Hevea discolor.* Hook. Ic. Pl. **26**: *pl. 2577.* Mr. 1899.

Hemsley, W. B. *Eryngium Rosei, E. tenuissimum, E. nasturtifolium.* Hook. Ic. Pl. **26**: *pl. 7579; 7580; 7581.* Mr. 1899.

Hill, E. J. *Carduus Hillii* perennial. Plant World, **2**: 127. My. 1899.

Hooker, J. D. *Cereus Paxtonianus.* Curt. Bot. Mag. **55**: *pl. 7648.* Ap. 1899.

Native of Brazil.

Jordan, E. The Production of fluorescent Pigment by Bacteria. Bot. Gaz. **27**: 19–36. J. 1899.

Kindberg, N. C. Studien über die Systematik der pleurokarpischen Laubmoose. Bot. Centralbl. **77**: 49–55. 4 Ja., 1899. **77**: 385–395. 8 Mr., 1899.

Langworthy, C. F. Mushrooms as Food. Plant World, **2**: 134–136. My. 1899.

Lutz, M. L. Recherches sur la nutrition des végétaux a l'aide de substances azotées de nature organique. Ann. Sc. Nat. Bot. VIII. **7**: 1–80. F. 1899.

MacDougal, D. T. Light and Vegetation. Pop. Sci. Month. **54**: 193–201. D. 1898.

MacDougal, D. T. Studies in Plant Physiology. III. Asa Gray Bull. **7**: 30–34. Ap. 1899.

MacDougal, D. T. Copper in Plants. Bot. Gaz. **27**: 68, 69. J. 1899.

MacDougal, D. T. Frost Formations. Bot. Gaz. **27**: 69–71. J. 1899.

MacDougal, D. T. Symbiotic Saprophytism. Ann. Bot. **13**: 1–46, *pl. 1–2*. Mr. 1899.

McDonald, F. E. Geographical Range of *Asclepias Meadii* and *Hypericum Kalmianum*. Plant World, **2**: 126, 127. My. 1899.

Morse, A. P. A new Method of pressing Plants. Plant World, **2**: 114, 115. Ap. 1899.

Murray, G. & Whiting, F. G. New Peridiniaceae from the Atlantic. Trans. Linn. Soc. **5**: 321–342, *pl. 27–33*. F. 1899.

Nash, G. V. New Southern Grasses. Bull. N. Y. Bot. Garden, **1**: 290–294. 13 Ap. 1899.

New species in *Paspalum*, *Diplachne*, *Tricuspis*.

Newcombe, F. C. Cellulose Enzymes. Ann. Bot. **13**: 49–81. Mr. 1899.

Nemec, B. Ueber die karyokinetische Kerntheilung in der Wurzelspitze von *Allium Cepa*. Jahrb. wiss. Bot. **33**: 213–334. *Pl. 3*. 1899.

Nemec, B. Zur Physiologie der Kern- und Zelltheilung. Bot. Centralbl. **77**: 241–251, *f. 1–7*. F. 1899.

Noack, F. Rebkrankheiten, in Brasilien beobachtet. Zeitschr. für Pflanzenkrankheiten, **9**: 1–10. *f. 1–4*. 31 Mr. 1899.

Overton, E. Beobachtungen und Versuche über das Auftreten von rothem Zellsaft bei Pflanzen. Jahrb. wiss. Bot. **33**: 171–231. 1899.

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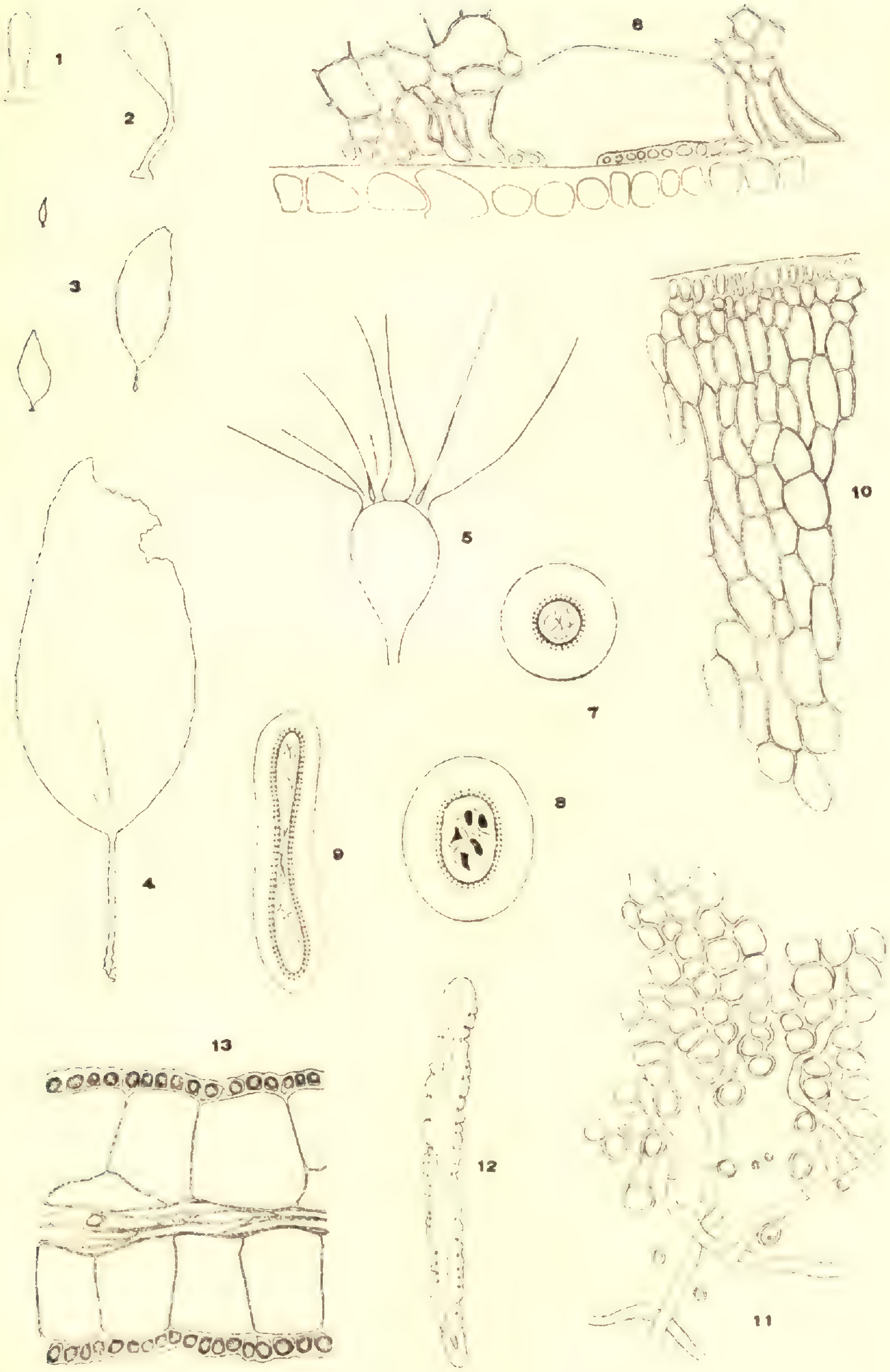
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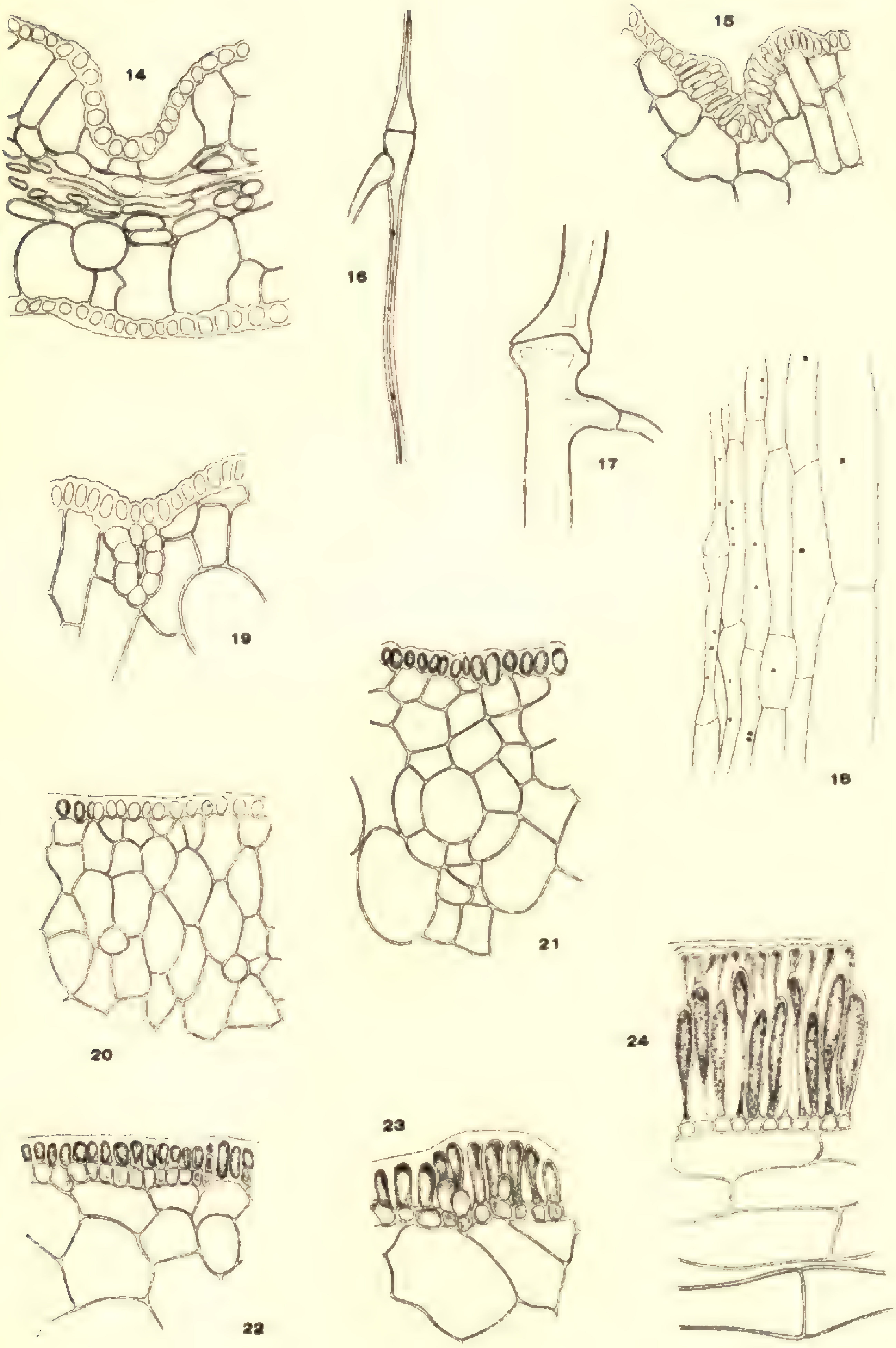
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NEREOCYSTIS LÜTKEANA.

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VOL. 26 No. 7

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OF THE

TORREY BOTANICAL CLUB

JULY 1899

Studies in Sisyrinchium.—III: S. angustifolium and some related Species new and old.

BY EUGENE P. BICKNELL.

The common Blue-eyed Grass of the eastern states, *Sisyrinchium angustifolium* Miller, may be taken as representative of a section of the genus *Sisyrinchium*, embracing those species having simple leafless stems with terminal spathes. The group of species so characterized, if not strictly a natural one, forms, nevertheless, a well-marked assemblage in the genus which it is altogether convenient to recognize. Nor is this subdivision entirely without natural status, for, taking the genus in North America as a whole, the degree of branching shown by the different species is seen to be correlated to some extent with their distribution. Thus the simple-stemmed species are, as a group, of more northern and alpine distribution than those which develop pedunculate spathes from one or more leaf-bearing nodes, while, on the other hand, the species having a definitely compound system of branching are all distinctively southern.

Little inconvenience appears to have resulted from our imperfect knowledge of this particular group of Blue-eyed Grasses, for long-established practice in the matter of identification has referred the simple-stemmed plants, one and all, to the species *S. angustifolium*, under whatever name designated. A very interesting series of distinct species has thus been overlooked.

No account is here taken of the northwestern *S. grandiflorum*

[Issued 18 July.]

Dougl., which forms a genus clearly distinct from *Sisyrinchium*, nor of the yellow-flowered California species, *S. Californicum* Dryand and *S. Elmeri* Greene, which again are not of the same generic type as our blue-flowered species. This matter will be discussed in a subsequent paper.

SISYRINCHIUM ANGUSTIFOLIUM Miller, Dict. ed. VII. 1759.

S. Bermudiana L. Sp. Pl. 954. In part. (?) 1753.

S. gramineum Lam. Encyc. **1**: 408. 1783.

S. anceps Cav. Diss. **6**: 345. *pl. 190, f. 2.* 1788.

S. montanum Greene, Pittonia, **4**: 33. 1899.

Tufted, or sometimes of scattered habit, commonly 20–30 cm. high (8–56 cm.) stiff and erect, more or less glaucous. Leaves usually ½ to ¾ the height of the stem and 1.5–2.5 mm. wide (1–3.5 mm.) linear and attenuate or sometimes slightly broadened upwards and acuminate, the edges usually serrulate-roughened: stems simple and leafless, or occasionally bearing a single leaf subtending one or two branches 5–12 cm. long, 1–2 mm. or even 3 mm. wide, wing-margined, the wings equaling or broader than the width of the proper stem, rarely narrower, more or less serrulate or denticulate-roughened, apparently never wholly smooth in the eastern plant: spathes erect, green or sometimes purplish-tinged; outer bract 2–6 cm. long, surpassing the inner one 1.5–4 cm., rarely less than twice its length, slenderly attenuate or broader and more abruptly acute, obscurely hyaline-margined, clasping for 2–6 mm. at base; inner bract 1.5–3 cm. long, hyaline-margined, acute to narrowly attenuate; interior scales silvery white, narrow, usually about half the length of the inner bract: flowers 1–8, violet-blue; perianth 10–12 mm. long; stamineal column 4–6 mm. high; pedicels erect or nearly so, 17–25 mm. long, shorter or slightly longer than the inner bract: capsules 4–6 mm. high, mostly oblong-subglobose and only obscurely trigonous pale, but often clouded with brownish-purple.

This species is far more widely distributed than any other one of its genus, ranging from Newfoundland and New Jersey to Saskatchewan and Montana and southward along the eastern mountains to Virginia and in the west to southern Colorado. I have seen no specimens from west of the Rocky Mountains.

It is scarcely to be thought that the species holds true throughout this wide range and indications are that, even as here limited, it is still something of an aggregate and will be found to include at least several geographical races.

The more eastern plant must, of course, be taken as typical of the species. It ranges from Newfoundland and Quebec south to New Jersey and in the Alleghanies to Virginia. Specimens from this general region show more or less discoloration from drying, but not nearly to the same extent as in *S. graminoides.* Specimens from Ontario to Saskatchewan and Colorado show little change of color on the herbarium sheet and differ further from the more eastern plant in being more glaucous and stiffer with leaves of rather thicker texture. Several specimens from British America are unusually slender and apparently small-flowered. Others from Minnesota are unusually stout and glaucous, and with some uniformity have the spathes brightly colored with red-purple quite in contrast with anything seen from elsewhere, although the eastern plant sometimes has the spathes tinged with dull purple. Still other specimens from Minnesota are tall and slender and apparently scarcely glaucous, the spathes long and narrow, the flowers on very slender pedicels and with delicately membranous perianth.

Several collections from Nebraska, well illustrated by Rydberg's no. 373 from Banner Co. and no. 1251, "Flora of the Sand Hills," are noteworthy by reason of stout central stem with relatively narrow and smooth-edged wing-margins, rather long pedicels and subglobose, corrugated capsules. Several of these specimens are branched. I have little doubt that this plant is entitled to a distinctive name.

Specimens collected in Newfoundland by Dr. Robinson and Mr. Schrenk are very small throughout with thin broadly winged stem and thin leaves, the capsules only 2 mm. high or less and on somewhat spreading pedicels; these specimens show quite as much discoloration as *S. graminoides.* Specimens from Mt. Desert Island, Maine, collected by Rand and Redfield are well developed examples of the usual eastern plant, and New Brunswick and Prince Edward Island specimens are similar.

The species comes into flower in most sections of its range from the middle of May till the middle of June, or later at high elevations. In the neighborhood of New York flowering is sometimes over in the second week of June. As far east as Newfoundland the flowering period is much later, from the end of June until late August, as shown by the collections of Waghorne and Robinson and Schrenk.

SPECIMENS EXAMINED.

Virginia: Mountain Lake, 4,000 ft. alt. Britton.

Pennsylvania: Pike Co., E. P. B.

New York: N. Y. Co., E. P. B.; Westchester Co., Mrs. E. G. Britton; Greene Co., Miss A. M. Vail; Chemung Co., Lucy; Cheango Co., Stewart; Tompkins Co., Rowlee, Kilbourne; Onondaga Co., Brower; Oswego Co., DeForest; Otsego Co.; Washington Co., Fitch.

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New Hampshire: Cheshire Co., Churchill.

Maine: York Co., Hill, E. P. B.; Mt. Desert, Redfield, E. P. B.

New Brunswick: Goodwin.

Prince Edward Island: Macoun.

Newfoundland: Robinson and Schrenk, Waghorne.

Quebec: Danville, Berg; Montreal, Kelly.

Ontario: Lambton Co., Dodge; Jones Falls, Fowler; Toronto Island, Armstrong; Casselman, Macoun; Lincoln and Welland McCalla.

Michigan: Jackson Co., Camp.

Assinoboia: Crane Lake, Macoun.

Saskatchewan: Bourgeau, 1858.

British America: Dr. Richardson.

Minnesota: Aitken Co.; Cass Co., Anderson; Cook Co., Cheney; Crow Wing Co., Sheldon; Lake Co., Sandberg; Mille Lacs, Sheldon; Pipestone Co., Menzel; St. Louis Co., Arthur.

North Dakota: Grand Forks Co., Bannon.

South Dakota: Black Hills, Rydberg, W. S. Rusby; Beadle Co., Douglass.

Montana: Park Co., Tweedy; Belt River, Williams; Custer, Blankinship; Madison and Gallatin Cos., Rydberg.

Nebraska: Ft. Union and Badland Creek, Hayden, 1853–4; Sheridan Co., J. G. Smith and Pound; Sioux Co., Williams; Banner Co., Rydberg; Cherry Co., Wilcox.

Colorado: North Boulder Peak, 6,500 ft., Pinard; Canyon City, Brandegee; Pike's Peak, Trelease; Ft. Collins, 5,000 ft., Baker; Table Rock, Crandall: Clear Creek, Englemann; South

Park, Wolf and Rothrock; Lorimer Co., 9,000 ft., Crandall; La Plata Mts., 9,000 ft., Baker, Earle and Tracy.

SISYRINCHIUM MUCRONATUM Michx. Fl. Bor. Am. **2**: 33. 1803.

Caespitose in close tufts often loosely invested below with the tangled and fibrillose remains of withered leaves; roots numerous and matted, very slender. Leaves and stems dull-green to glaucescent, slender, the leaves commonly half the height of the stem, but sometimes equaling it, varying from capillaceous to 2 mm. wide, taper-pointed, smooth-edged or minutely denticulate or serrulate. Stems numerous, 10–46 cm. tall, varying from capillaceous and merely margined to 1.5 mm. wide and narrowly winged, the edges very smooth to denticulate-roughened, simple or occasionally short-branched at the top; spathes straight or slightly bent, the thin bracts smooth or, exceptionally, obscurely scabrous, usually or often bright red-purple, but varying to green, narrowly hyaline-margined, the outer one 1.8–5.7 cm. long, united-clasping for 1–4 mm. at base, the slender prolongation surpassing the inner bract 4–28 mm.; inner bract emerging gradually from the outer one, 10–16 mm. long, herbaceous, attenuate and acute, or the apex obtuse and scarious or even bifid; interior scales narrow and attenuate, mostly about half the length of the inner bract. Flowers 2–7, mostly deep purple-blue, sometimes white; perianth 6–14 mm. long; stamineal-column 4–5 mm. high: capsules on slender somewhat spreading pedicels 1–2 cm. long, 2–4 mm. high, trigonous, subglobose, broadly oblong, or somewhat obovate, not impressed at base, sometimes even narrowed into the pedicel, thin-walled, pale but usually purplish-tinged at maturity; seeds subglobose, black, pitted and prominently umbilicate, 1–1.2 mm. in diameter.

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Michigan: St. Clair Co., C. K. Dodge; Ontario: Lambton Co., C. K. Dodge, Wingham, J. A. Morton; New York: Ithaca, Herb. Cornell Univ.; Pennsylvania: Union Co., H. R. Noll; Monroe Co., N. L. Britton, E. P. B.; Pike Co., E. P. B.; Philadelphia, A. B. Monoy; Isaac P. Martendale (1872); Washington, D. C.: Lester F. Ward, G. McCarthy; Virginia: Dyke, T. H. Kearney, Jr.

It is at last possible to understand this long misdoubted species of Michaux and to dispel the uncertainty which has always attached to the exact application of its name. The species is a perfectly authentic one and has failed of recognition evidently because never properly distinguished from the commoner and far more widespread *S. angustifolium*, a plant of similar habit, but stouter and more glaucous and differing especially in its much larger fruit.

While the distinctness of these two plants is not at all a matter of doubt, the variation of *S. mucronatum* is so considerable that, in order to define that species understandingly it will be well to give sharper definition to the type as contrasted with certain stouter forms of the plant which take on more the likeness of *S. angustifolium.* Michaux's description can no longer be misunderstood and the type of *S. mucronatum* may be confidently taken as the smallest form of the plant markedly set apart by almost capillaceous stem and leaves, small flowers and conspicuously red-purple spathes. This is an exceedingly delicate and attractive little plant rendered especially striking by its close and numerous capillary appearing stems tipped with the bright-colored spathes. In this extreme form of the plant the tufts are but 10–20 cm. high and the leaves and stems only .5–1 mm. wide, the latter merely margined and with the edges mostly very smooth. The leaves, commonly about one half the height of the stems, are erect and almost setaceous, the edges sometimes obscurely roughened at the apex. The narrow spathes have the outer bract 12–24 mm. long and aristulate-prolonged for 5–12 mm. beyond the inner one which is scarious-obtuse or bifid at the apex and apiculate from the midnerve; the flowers are few and small, the perianth appearing to be only 6–8 mm. long, on capillary, exserted, somewhat spreading pedicels 10–16 mm. long, fruit not seen.

In this typical state the plant cannot possibly be confused with any other species; nevertheless it appears to pass into an every way larger form the extreme state of which simulates forms of *S. angustifolium* from which, however, the smaller, more globose fruit readily distinguishes it. The stoutest example seen, from Washington, D. C., has larger flowers than occur in any other eastern species the perianth being 12–14 mm. long.

A form of the plant found by Dr. Britton and myself fruiting in abundance in a damp meadow near Tannersville, Pa., July 4, 1896, is tall and slender the numerous leaves nearly as long as the stems, many of which bear a bracteal leaf near the top subtending one or two peduncles. The plants were pale in color and the more branched forms bore rather a close resemblance to forms of *S. Atlanticum.*

In two or three of many specimens the bracts of the spathe are very obscurely scabrous.

The forms of the plant here referred to look remarkably different from the type, but the extremes appear to intergrade and the expediency of recognizing any of them as varieties does not clearly appear from the material at present before me.

Sisyrinchium campestre sp. nov.

Closely caespitose, commonly 15–20 cm. high (10–30 cm. or more) erect, stiff, glaucous or glaucescent. Leaves half the height of the stem or longer, sometimes surpassing the stem, 1–1.5 mm., rarely 2 mm. wide, the edges smooth, the bases tinged with pale dull purple: stem .5–1.5 mm. wide, narrowly wing-margined, the wings finely close-striate, often obscurely scabrous on the sides, especially above, the edges smooth; spathe pale dull purple to green, the bracts minutely roughened with somewhat glandulose points to canescently scabrous-puberulent, or sometimes glabrous, primary bract 2.5–4.5 cm. long, narrowly attenuate, often setaceously slender, stiff and straight or slightly incurved, obtuse or acute, surpassing the inner bract 1–2.5 cm., the margins narrowly hyaline below, not at all united-clasping at the base or but slightly so; base of inner bract usually rounding out rather abruptly from the primary one, especially at full maturity, giving the spathe a somewhat gibbous character, the bract 1.2–2 cm. long, narrowed or slenderly attenuate to the acute apex, the edges noticeably white-hyaline; interior scales commonly broader than in *S. mucronatum*: flowers 4–9, pale blue to white; perianth delicate, 8–14 mm. long; stamineal column 3–5 mm. high; pedicels 10–16 mm. long, usually not surpassing the inner bract and little spreading: capsules pale at maturity, 2–4 mm. high, trigonous-subglobose, often depressed, and impressed at base but sometimes cuneate-obovate, sparsely puberulent, minutely rugulose, sometimes also venose-reticulated; seeds few in each cell, 1–1.25 in longer diameter, irregularly obovoid-subglobose or oblong, somewhat angled, black, at full maturity, only faintly pitted umbilicate.

Wisconsin to North Dakota, south to Louisiana, Oklohoma and the mountains of New Mexico, on prairies, in meadows and in rocky open woods, flowering in May and June.

Wisconsin: Madison, Trelease.

Minnesota: Chicago Co., Taylor; Goodhue Co., Sandberg; Hennepin Co., many collectors; Meeker Co., Frost; McLeod Co., McElligott; Nicollet Co., Ballard; Ramsey Co., Sheldon; Swift Co., Payne; Waseca Co., Taylor.

North Dakota: Geyer (1839).

South Dakota: Clay Co., Geyer; Lincoln Co., Redfield.

Nebraska: Lancaster Co., Webber; Saline Co., Siegreist, Hayden (1853).

Missouri; Atchison Co., Bush; Jackson Co., Bush; Jefferson Co., Englemann (1862).

Kansas: Riley Co., Bassler, Norton.

Arkansas: Nuttall.

Oklahoma: Waugh.

New Mexico: Hermit's Peak, Snow.

Illinois: Menard Co., Hall.

Iowa: Fayette Co., Fink; Pottawattamie Co., Hayden; Story Co., Hitchcock; Winneshiek Co., Collett.

Louisiana: Natchitoches Co., Hale.

Nearly allied to *S. mucronatum* Michx. certain forms of the two plants even appearing scarcely different—always a logical expectation from conditions of close relationship between plants, however distinct. Notwithstanding such dubious forms, the normal development of the two plants takes place along obviously different lines. In its typical state *S. campestre* is mostly a more glaucous plant than *S. mucronatum*, of stiffer habit, with smooth-edged stem and leaves, and paler blue or frequently white flowers on rather less exserted pedicels; the spathe is relatively larger with stiffer primary bract, and though often of a dull pink-purple shade never develops the bright red-purple color so conspicuous in typical *S. mucronatum*; its bracts are also usually less membranous than in *S. mucronatum*, the outer one scarcely if at all united-clasping at the base permitting a more abrupt protrusion of the inner one which tends to be more broadly hyaline along the margins.

The close relationship of the species to *S. mucronatum* would lead to an expectation of somewhat parallel lines of variation in the two plants. These, indeed, prove to exist. Furthermore, *S. campestre* is nearly related to the twin-spathed species, *S. albidum*

Raf., just as *S. mucronatum* is nearly related to the twin-spathed *S. scabrellum*, only with this reversal in the terms of the relationship that, in the one case the rough-bracted plant is the one with the solitary spathe, in the other case the one with the spathes geminate.

Several more or less well-defined strains of variation may be traced running through herbarium material of *S. campestre*, but there is no sufficient evidence that these represent anything more than mere states of the species, any one of which might appear under the appropriate conditions of soil and situation.

The form taken as typical has the stem 1–1.5 mm. wide, commonly much surpassing the slightly broader leaves, and densely scabrous-puberulent spathes often of a pale purple color, the primary bract acute or obtusely pointed and surpassing the inner bract 1–2 cm., the inner bract 1–2 cm. long, herbaceous attenuate or hyaline-margined to the acute apex, the flowers usually light-blue and about 10 mm. long on slender pedicels subequal with the inner bract.

This plant is common in Minnesota, extending west to the Dakotas and south to Missouri and Kansas.

A few specimens from Minnesota are unusually stiff and glaucous, with the perianth sometimes 14 mm. long.

Certain other specimens are greener, the spathes showing little or no purplish tinge, the inner bract often broader and having the more scarious margins somewhat abruptly narrowed to the shorter tip.

A small proportion of specimens have the bracts quite smooth. Such plants seem to be rare as far north as Minnesota, but more frequent further south; they show a tendency to a slightly broader stem than the type, especially near the base of the spathe, and broader inner bract, and are frequently white-flowered, apparently representing a transition to the variety *Kansanum* described below. Specimens of this smooth-bracted plant are, on technical characters, sometimes with difficulty separable from *S. mucronatum*, but as a rule are rather stouter, with smooth-edged stem, stiffer leaves, broader inner bract and less united outer one.

Differing strikingly from the type when extreme forms are compared but appearing to intergrade with it is a very slender form which is frequent or common in Minnesota and Missouri. The leaves are relatively long and with the stems mostly less than 1 mm. wide, the spathes small and slender in proportion, the outer bract and frequently the inner one very slenderly attenuate. Certain of these slender specimens from Minnesota have numerous unusually elongated leaves considerably surpassing the stems, very short spathes and pedicels and capsules only 1.5–2.5 mm. high; some of these specimens have no purplish tinge in the bracts and appear to be scarcely glaucescent; rarely their bracts are quite glabrous.

Sisyrinchium campestre Kansanum var. nov.

Pale and glaucous, rarely showing any purple tinge in the bracts, 15–30 cm. high. Leaves stiff and erect, straight or falcate, often equaling the stem, 1–2.5 mm. wide, closely striate, mostly cuspidate-acute, smooth-edged, sometimes when young roughened on the sides with minute points: stems 1–2 mm. wide, the wings mostly wider than the proper stem and perceptibly broadened into the base of the spathe, striate, the edges smooth; sides of the stem sometimes minutely roughened especially near the top: spathes stiffly erect, the broad base appearing abruptly transverse across the top of the stem, the bracts herbaceous and striate, smooth or rarely obscurely scabrous; primary bract stiff, erect or curved, slenderly prolonged, 2.5–6.5 cm. long, surpassing the inner bract 1.2–3.0 cm., blunt-pointed or slenderly acute, the margins below narrowly white-hyaline, usually not at all united at the base; inner bract 1.5–2.7 cm. long, broad below and abruptly emerging from the outer one, keeled, herbaceous-attenuate or the broad white-scarious margins abruptly narrowed to the obtuse or merely acute apex. Flowers white, large, the perianth delicate, sometimes over 14 mm. long, its divisions obovate-oblong, apparently not emarginate and very short aristulate; stamineal column 4 mm. high; pedicels 12–17 mm. long, shorter than the inner bract, more or less margined: capsules apparently not larger than in *S. campestre*, trilobulate-subglobose, 3–5 mm. high, glandular puberulent when young; mature seeds not seen: roots stronger, darker and less fibrillose than in *S. campestre*.

Eastern and middle Kansas and Oklahoma, doubtfully from southeastern Nebraska and western Missouri, occurring on prairies and flowering from the middle of April into June. Kansas: Davis Co., Ft. Riley, April 27, 1892, type, in Herb. Columbia University; Riley Co., J. B. Norton, T. Bassler; McPherson Co., J. E. Bodin; Douglas Co., "J. G. B." Oklahoma: "Waugh."

In its fully developed state this plant presents so striking a contrast with usual forms of *S. campestre* that there would seem to be little doubt of its being a distinct species; nevertheless, forms apparently intermediate between the two occur with them. It is evidently impossible to determine the exact status of the plant from present material.

Sisyrinchium flaviflorum sp. nov.

Tufted, about 25 cm. high, dull green and glaucescent; older roots coarse and simple or nearly so. Leaves about three-quarters the height of the stems, 1–2 mm. wide, the larger ones broadened upwards, acute, striate, the edges nearly or quite smooth: stems 1.25–2 mm. wide, stiff and erect or sometimes curved, broadened into the base of the spathe, the wings prominently striate, smooth-edged; spathes green, 4–5 mm. wide near the base; primary bract very large and foliaceous, often curved, about 6 cm. long, obtusely pointed, surpassing the second bract 3–4 cm., very narrowly hyaline below, the margins free to the base; inner bract 2–2.5 cm. long, hyaline-margined, herbaceous attenuate to the obtuse apex, emerging rather abruptly from the base of the spathe: flowers apparently few on pedicels 10–15 mm. long, much shorter than the inner bract; perianth clear lemon yellow, about 12 mm. long, apparently of rather thick texture and minutely granulose-glandular, the divisions abruptly rounded or truncate at the tip, very short aristulate; column about 5 mm. high; anthers rather large, 2–2.5 mm. long, apparently less contiguous than in allied species with the filaments less coherent at the top; young capsules obovate-oblong, glandular-puberulent.

Missouri: Courtney, B. F. Bush. Type in Herb. Missouri Bot. Gard., June 7, 1892, just in flower.

Similar in general appearance to large examples of *S. campestre Kansanum* but of a peculiar dull green color with larger spathes and especially larger and more foliaceous primary bract. The flowers, however, afford the most distinctive feature of the plant and appear to be peculiar in texture as well as in color, and in larger anthers as compared with related forms.

Mr. B. F. Bush, of Courtney, Missouri, the discoverer of this interesting plant appears to be the only person who has ever met with it. Specimens sent by him some years ago to the Gray Herbarium were referred to by Dr. Watson as being probably a form of *S. angustifolium* (Gray's Manual, ed. 6, 735).

Mr. Bush writes me in regard to this plant that it grows in open Black Jack woods on the borders of prairies, while *S. angustifolium* (*S. campestre*) grows on bare prairies and *S. graminoides* in wet meadows. It does not occur with either of the other two species and only occurs in two or three localities near here, Courtney, Mo.

SISYRINCHIUM ALBIDUM Raf. Atl. Jour. 17. 1832.

Dull or rather bright green, the spathes often tinged with dull red-purple, glaucous or glaucescent, commonly 30 cm. or less high (15–46 cm.). Leaves about half the height of the stem, mostly 1.5 mm. wide (.5–3.5 mm.), very acute, smooth-edged, but often serrulate above or sometimes throughout: stems commonly 1.5 mm. wide (1–3 mm.), often very flat, the wings thin and striate, usually broader than the proper stem, serrulate or hispidulous on the edges or sometimes smooth: spathes two, contiguous and sessile at the top of the stem or rarely the outer one pedunculate on a short divergent branch, each two-bracted; primary bract 2.5–7 cm. long, foliaceous or slenderly attenuate, acute or obtuse, surpassing the inner bracts 1.2–5 cm. the edges free to the base and scarcely hyaline; outer bract of second spathe 1.3–2.7 cm. long, hyaline-margined, the tip herbaceous, sometimes obtuse, but usually acute or attenuate, subequal with its fellow or surpassing it by as much as 12 mm.; keels of inner bracts often ciliolate; interior scales about three quarters the length of the shorter bracts: flowers varying from clear white to violet-blue, sometimes as many as nine in each spathe; perianth 8–12 mm. long; stamineal column 4–5 mm. high: capsules pale, rather thick walled, depressed-subglobose, 2–3 mm. high on slender, erect, or slightly spreading pedicels 10–22 mm. long, little if at all longer than the shorter bracts: seeds black, globose, prominently umbilicate, distinctly pitted .75–1 mm. in diameter.

Alabama and Louisiana to Missouri and Michigan; North Carolina. Flowering in early April in the extreme south, in April and early May as far north as southern Illinois, in late May and early June in northern Illinois and Michigan.

Alabama: Tuscaloosa Co., Dr. E. A. Smith.

Mississippi: Oktibbeha Co., S. M. Tracy.

Louisiana: Dr. Hale.

Tennessee: Sewanee, E. Kirby Smith.

North Carolina: Stanly Co., W. W. Ashe.

Kentucky: Dr. C. W. Short (1840); Warren Co., Miss Sadie F. Price.

Missouri: St. Louis Co., Dr. Englemann (1838–1865).

Illinois: Hancock Co., S. B. Mead (1842); Cook Co., Dr. W. Moffat.

Indiana: Tippecanoe Co., A H. Young.

Michigan: Cass Co., C. F. Wheeler; Jackson Co., C. F. Wheeler, S. H. & D. R. Camp; Ingham Co., C. F. Wheeler; Livingston Co., C. F. Wheeler, Belle Isle, Detroit River, O. A. Farwell; Keeweenaw Co., O. A. Farwell.

It is difficult to frame an exact definition of this plant from present material which, while fully attesting the distinctness of the species from the old *S. angustifolium* and the more nearly related *S. campestre*, appears to point to a still further problem in segregation while not permitting its solution. In appearance the plant is similar to *S. angustifolium* or, in its more slender forms, to *S. campestre* but differs from both in its uniformly twin spathes and from the former in mostly white or pale blue flowers and smaller fruit.

The type locality for the species is West Kentucky and specimens from this general region have been more particularly held in view in the foregoing description. So far as specimens and notes on labels indicate the plant is here uniformly white-flowered. Specimens from prairies near Chicago have large very pale blue flowers and unusually long bracts, which on a few of the plants are obscurely scabrous on the sides, a feature shown only by one other specimen of my series, also from Illinois.

From Sewanee, Tenn., comes a specimen having apparently very small blue flowers and capsules but 1 mm. or less high. The only specimen seen from Louisiana is very pale in color and has stout spathes with long, slenderly attenuate primary bracts; the apparently small flowers are white on somewhat slenderly exserted pedicels. Specimens collected in Mississippi by Prof. S. M. Tracy are noteworthy from their large size and broad leaves and stems, the former becoming 3.5 mm. wide; the spathes are unusually stout, the pale blue flowers seemingly of medium size. Contrasting so markedly with these as to seem quite distinct yet apparently connected by intermediate forms, are certain specimens from Michigan communicated by Professor C. F. Wheeler and Mr. O. A. Farwell. These are extremely slender, the stems and leaves from .75–1.5 mm. wide, the spathes abruptly broader than the stems and with the outer bracts unusually slender and elongated; the blue flowers are rather small and delicate. Some of these specimens seem to be scarcely if at all glaucous and with thinner leaves and bracts than other forms; the stems are mostly only narrowly winged.

Sisyrinchium heterocarpum sp. nov.

Apparently but little tufted, bright green or yellowish green, glaucous, stiff and erect, 20–30 cm. high; roots pale, fleshy, tapering from thickened bases sometimes 2 mm. wide. Leaves half the height of the stem or longer, 1–2 mm. wide, tapering, acute, the edges smooth: stem 1–1.5 mm. wide, narrowly winged, the edges smooth or bearing some minute harsh points towards the base: spathes sometimes slightly purplish tinged, erect, narrow, sometimes scarcely exceeding the width of the stem, sometimes becoming 2–3 mm. wide about the middle; inner bract often weakly developed or inconspicuous, 1.5–2 cm. long, scarious-margined usually to the acute apex; outer bract 2.5–4.5 cm. long, above slender and acute, surpassing the inner bract 1–2.5 cm., the lower margins hyaline, united for 3–5 mm. at base: perianth violet-purple, about 10 mm. long; stamineal column 5 mm. high: capsules of two kinds, terminal and basal, the latter more or less concealed among the bases of the leaves, those from the terminal spathes few, 1–4, pale, subglobose or sometimes obovoid, rather large, 5–7 mm. high on erect scarcely exserted pedicels only 10–20 mm. long; basal capsules 2–4, on slender erect pedicels 2.5–3.5 cm. long, obovoid-pyriform, 7–10 mm. long from the narrowed base, 4–5 mm. wide, rather thinner walled than the terminal ones and more or less transversely corrugate conformably with the position of the seeds, a feature less evident in the terminal capsules: seeds (not quite mature) black, obovoid-subglobose, angled and rugulose-pitted, stipitate, 1 mm. in diameter.

Wyoming: Cummins, July 30, 1895, in full flower and with immature fruit; Table Mountain, June 30, 1895, in full flower and with immature fruit; Dubois, August 10, 1894, nearly mature fruit and immature flower buds.

An interesting plant known only from the collections of Professor Aven Nelson. In general aspect of leaf and stem it closely matches slender forms of *S. angustifolium* to which species it is evidently nearly allied.

The development of basal flowers and fruit is an unexpected character in the genus and were it shown by a single specimen only might reasonably be referred to an abnormal condition. It is however exhibited by five perfectly healthy examples collected at different times in three distinct localities.

The origin of these basal flowers may perhaps be referred to suppressed development of the usual stem. They occur either in separate leaf clusters or among the leaves about the bases of normal stems, but in the latter case although enclosed by the same outer leaves as the stem they nevertheless belong to an inner tuft of leaves which arises from a separate point of the axis.

Some plants show no indications of these radical flowers and are then with difficulty separable from *S. angustifolium.* The plant appears to need comparison with no other species than this. It differs in narrower mostly smooth-edged leaves and stem, smaller and narrower spathes, less developed inner bract, shorter pedicels and larger more globose or pyriform paler capsules, often transversely corrugate. The thickened roots are a further noteworthy character. The few flowers seen are rather smaller than those of *S. angustifolium,* the divisions of the perianth less rounded at the apex and more distinctly aristulate, the yellow eye also appears to be larger.

In some specimens the basal and terminal capsules are of about equal age; others show at the same time basal capsules nearly mature, and upper spathes still tightly enclosing their flower buds. The successive opening of the flowers appears to be remarkably prolonged or irregular for several spathes which bear nearly mature capsules also enclose very immature flower buds.

Mounted on several sheets among fruiting specimens are a few plants just in flower which are larger, stouter and broader leaved with longer pedicels; these are apparently not distinguishable from *S. angustifolium* and may be referable to that species. They are, however, of the same bright, pale-green hue of *S. heterocarpum,* with smooth-edged stems, and their time of first-flowering, August, is hard to reconcile with what is known of the flowering period of *S. angustifolium.* A few of the specimens of *S. heterocarpum* show some stems stouter than the others and somewhat approaching these. Evidently the plant in all its phases cannot be fully understood from present material and its exact relationship to *S. angustifolium* must remain a subject for future study.

New Plants from Wyoming.—IX

By Aven Nelson

Ranunculus alpeophilus

Similar to *Ranunculus Eschscholtzii* in habit, usually larger, bright green, nearly glabrous throughout: leaves sparsely and obscurely ciliolate on the margins; the radical orbicular-flabelliform to nearly reniform, some of them coarsely crenately toothed, others incisely lobed, the middle lobe lingulate, the lateral ones unequally toothed, more rarely divided nearly to the base; stem leaves few, near the summit and somewhat involucrate, divided nearly to the base into oblong lobes, the lateral lobes sometimes again lobed or toothed: flowers mostly 3, surpassed by the leaves, the pedicels elongating in fruit: calyx glabrous or nearly so: akenes broadly oval or obovate.

To be distinguished from *R. Eschscholtzii* by being nearly glabrous even as to the calyx, by the broader and less divided radical leaves, by the long lobes (3–5 cm.) of the upper leaves and by the broader summit of the akenes.

It is probable that much, if not all, of the material from the middle Rockies, that has been distributed as *R. Eschscholtzii*, belongs to this species. Several collections of it have been secured, from nearly alpine stations in this State, growing in moist, rich soil. Nos. 1780 and 4211 by the writer, and no. 5252 by Mr. Elias Nelson may be cited as typical.

Arenaria pinetorum

Root and caudex woody, the latter freely branched, its slender branches clothed with the dead leaves and partly buried in the loose soil: stems singly from the crowns, minutely glandular-puberulent, 6–15 cm. high, of several internodes: leaves smooth or nearly so, linear, 2–5 cm. long, somewhat crowded on the crowns, rigid and needle-pointed; those of the stems exceeding the internodes (often twice as long), the uppermost becoming scarious and passing into the scarious, lanceolate bracts: cyme short and dense, the bracts conspicuous: sepals rigid, linear-lanceolate, scarious margined, pungent, about 7 mm. long: petals narrowly oblong, distinctly exceeding the sepals (about 10 mm. long).

This species is to be compared with *A. Hookeri* Nutt. from which it is clearly separated by 1. Habitat: *A. Hookeri* forms broad cespitose tufts on open ground, mostly on naked, clay, saline soils, as I have observed it throughout the breadth of Wyoming; this forms single, compact clumps in the shaded woods, growing in the pine and spruce needles: 2. Characters: *A. pinetorum* is larger than the other in every way; the branches of the caudex longer, the leaves longer and more slenderly pungent, exceeding (even twice as long as) the internodes, while in *A. Hookeri* the leaves are shorter than the internodes.

While it resembles *A. Hookeri* in its inflorescence, yet the cyme is more open, the flowers are larger and the petals distinctly exceed the sepals. As seen in the field they can never be confused, the bushy clumps of this and the cespitose mats of *A. Hookeri* being markedly distinct. Type specimen in Herb. University of Wyoming, no. 1595, Laramie Peak, Aug. 7, 1895. It has been distributed under the above number as *A. Hookeri*.

Cheiranthus aridus

Biennial, possibly more enduring, bushy branched, usually many stemmed from the crown of the vertical taproot, sometimes with an excurrent stem with several divaricate branches, mostly low, rarely 3 dm. high: leaves oblanceolate, acute, entire or nearly so, 4–8 cm. long, green in appearance but rather closely pubescent with small, 2-parted appressed hairs: sepals narrowly oblong; corolla large; the petals 16–20 mm. long, blade narrowly obovate or broadly spatulate, shorter than the slender claw: commencing to flower when small and fruiting copiously; pods long (8–12 cm.), sub-terete or elliptic in cross-section, not taper-pointed but abruptly contracted into a short style; valves distinctly 1-nerved.

Since the publication of Dr. Greene's paper on *Cheiranthus* (Pittonia, **3**: 128) any one who has tried to arrange a considerable amount of material in this genus according to the specific limits there proposed has not only found it feasible, but has found the disposition of material in this group much simplified. It was to be expected that the breaking up of the aggregate, *Erysimum asperum*, into its species would disclose forms that now cannot be united with any of those species, though they might have found oblivion among the miscellany of the old *E. asperum*. Such is the species now proposed which, though allied both to *C. asper* and *C. asperimus*, species of this range, is quite distinct from them, by its bushy branched habit, its greener aspect, its profusion of flowers and fruit, the sub-teretish pod which is curved-ascending and with a distinct style. As is well known, *C. asper* has a simple stem, the pods are straight and strongly divaricate: in *C. asperimus* the pubescence is harsh and cinereous and the pods strikingly "flatly 4-sided."

This species has not been secured except in the desert region of south-central Wyoming. Here it is greatly abundant and, as observed throughout a large area there, it maintains its habits and characters as before given. In the eastern part of the state and again in the western, in soils very different from those of the desert, *C. asper* is the prevailing form.

Type specimen in Herbarium University of Wyoming, no. 4731, Green River, June 13, 1898.

Draba andina

D. oligosperma Hook. var. β? *andina* Nutt. T. & G. Fl. N. A. **1**: 104.

That this very rare plant has again been secured there can be little doubt. Again it is only in fruit, but the fruit characters are sufficiently distinctive so that no violence is done in establishing it as a species on habit, leaf and fruit characters only. Then, too, it appears that it should not be associated with *D. oligosperma*. It has the same habit, but the branches of the caudex are shorter, leaves shorter and more closely imbricated and the fruiting raceme (scape) shorter. The pods are oval to orbicular, about 3 mm. long and the cells mostly 2-seeded: style about half as long as the pod; stigma disk-shaped.

The original locality for this is given as "summits of lofty hills toward the source of the Platte." These specimens were collected in the Freezeout Hills, in the drainage basin of the upper Platte, on naked clay ridges, a very different habitat from that of *D. oligosperma*. Type no. 4487, collected by Mr. Elias Nelson.

Arenaria verna equicaulis

Perennial from a very slender woody root; intricately branched at the base, finely viscid pubescent throughout: stems filiform, very numerous, erect from a decumbent base, nearly uniform in length on the same plant, differing considerably in different plants (3–6 cm. long): leaves crowded at the base, few and much reduced above, linear subulate, not pungent, thick, semi-cylindric, three-nerved, nearly glabrous: floral characters nearly those of the species but for the nearly uniform length of peduncles and pedicels.

No doubt others have felt that the specimens occasionally distributed from this portion of the Rocky Mountains as *A. verna hirta* Wats. were very different from the Arctic plant of that name. Since the difference lies largely in habit and leaf character it may be considered less fundamental than if floral or fruit characters were involved. However, on comparing these plants, which so constantly form sub-spherical individual tufts of compactly grown stems and semi-terete leaves, with the flat leaves and lax stems and the inflorescence of the other it seems that they ought to be segregated. This plant is not at all rare, specimens of it having been secured in the Big Horn Mountains, in the Laramie Hills and in the Medicine Bow Mountains. It must be considered alpine, though occasionally it descends to sub-alpine stations. The last collection was at about 12,000 feet. Excellent specimens of it were distributed as *A. verna hirta* from Estes Park, Colo., by Mr. C. E. Osterhout in 1897.

Polemomium Haydeni

Root large, woody, more or less branched, surmounted by a short, woody, branched caudex: stems several, one or more from each crown, corymbosely few branched above, a somewhat reduced leaf at each node, 2–3 dm. high, the minute puberulence becoming glandular above: leaves crowded on the crowns, more than half as long as the stems; leaflets 15–25, oval, oblong or oblanceolate, mostly very small, rarely exceeding 1 cm. in length, glabrous or nearly so, flowers numerous and rather crowded, drooping or suberect, on slender pedicels: calyx narrowly campanulate, about as long as the corolla tube: corolla blue, tubular-campanulate, 12–16 mm. long, the broadly elliptic lobes a little longer than the calyx: filaments very slender, the base slightly dilated and sparsely pilose: seeds 2–3 in each cell.

A beautiful species, probably most nearly related to *P. humile pulchellum* but much larger and more tufted; to be at once separated by its large, woody root and caudex. Three perfect specimens of this are found in the Herbarium of the Mo. Bot. Garden, collected by Dr. F. V. Hayden, on Capt. Raynold's expedition, on Snake River, in Jackson's Hole, Wyo., June 15, 1860. These are cited as the types.

Polemonium mellitum

P. confertum mellitum Gray, Proc. Acad. Philad. 1863: 73; Proc. Am. Acad. **7**: 280.

This plant is so well known that it does not seem necessary to redraw the description but some of the differences between it and *P. confertum* Gray, which seem to entitle it to specific rank, may be pointed out.

P. mellitum is larger, more spreading, usually in large clumps, leafy above, the leaves lax, those of the stems nearly equalling the inflorescence; leaflets larger, thin (almost membranous); flowers larger, white or cream white, conspicuously green-bracteate. In strong contrast to this is the strict habit, erect leaves, small, thick, crowded leaflets, rather scapose stems and deep blue flowers of *P. confertum.*

P. mellitum inhabits sub-alpine stations, its dense tufts clinging in the crevices of rocky ledges. *P. confertum* occurs from sub-alpine to alpine heights, often on open slopes and mostly as single specimens. Though the two may occur together yet in several collections of each, I have never found them so.

Pentstemon Crandallii

Densely cespitose; the caudex intricately branched; roots numerous, coarsely fibrous, fascicled; stems numerous, tufted, ascending or erect, slender, 6–12 cm. long, obscurely grandular-puberulent, toward the summit and on the pedicels glandular-puberulent: leaves dense, glabrous or nearly so, green, slightly wrinkled on the surface when dry, linear, or generally narrowly oblanceolate, acute, slender petioled (sometimes with a broadish base), 15–25 mm. long: bracts similar to the leaves, but much smaller, only 8–10 mm. long: flowers axillary, borne singly or 2–3 in a cluster, erect, even the uppermost overtopped by the upper leaves: sepals about 7 mm. long, slightly exceeding the proper tube of the corolla, ovate as to the base, long acuminate, basal portion scarious margined: corolla about 2 cm. long, tube short, not strongly dilated above, the short lobes nearly erect, lower lip nearly glabrous within: sterile filament yellow-bearded for one-half of its length: anther cells dehiscent through the junction of the two cells, but not explanate.

The nearest ally of this strongly-marked species is *P. caespitosus* Nutt. From this it is distinguished at once by its more intricately branched caudex and root system; its longer, tufted, erect stems; its larger, acute leaves, and its green, glabrate aspect. The matted, cinereous appearance of the other is in strong contrast to this species.

I am indebted to Professor C. S. Crandall for specimens of this plant, collected by him near Como, Park County, Colorado, July 23, 1897.

Pentstemon Coloradoensis

Tufted, with woody roots and woody, multicipital caudex, minutely but closely cinereous-pubescent throughout: stems slender, numerous and somewhat fascicled on the bases of the stems of the previous years, erect or nearly so, developing unequally, many merely small, leafy shoots, the longer ones 2–3 dm. high (including the inflorescence): leaves crowded on the bases of the stems and on the sterile shoots, nearly linear, acute, tapering slightly to the base, 10–25 mm. long: floral leaves gradually reduced, the uppermost subulate bracts: inflorescence secund, mostly strictly so, the lower peduncles about 4-flowered, shorter and fewer flowered upward: sepals ovate, acuminate, scarious margined, about as long as the corolla tube proper: corolla blue, tubular-funnelform, about 15 mm. long, not strongly bilabiate, the lobes moderately spreading, sparsely bearded on the lower lip: sterile filament short, with a close, short, yellow pubescence: anther cells dehiscent through the junction of the two cells.

Of this species I have before me specimens from two collections made near Mancos, Colo., by Messrs. Baker, Earle and Tracy, 1898 and distributed as *P. caespitosus* Nutt. Also from two collections by Professor Crandall, from Hotchkiss, Colo., 1892, and from Durango, 1898, both distributed as *P. linarioides Sileri* Gray. This latter is the species to which *P. Coloradoensis* is most closely allied, but is to be distinguished by its different habit, its fascicled, virgate stems, the acute (not mucronate) leaves, the secund inflorescence, the blue corolla and the sparse beard on the lower lip.

Grindelia perennis

Root woody, usually with numerous, slender secondary ones: stems several to many from the crown (single in young plants), simple and decumbent at base, paniculately-corymbose branched above, 3–5 dm. high, glabrous as are also the leaves: rather leafy above, more sparsely so downward, the basal early deciduous: leaves entire or remotely denticulate, the basal and lowest cauline short-petioled, oblanceolate, becoming sessile and even auriculate-clasping upward, the middle cauline oblanceolate, 4–7 cm. long, the uppermost oblong or reduced to mere bracts: heads rather numerous, 2 cm. broad in anthesis, the rays numerous (20–30), about 1 cm. long: involucral bracts glutinous, strongly recurved in young undeveloped heads, only slightly squarrose at maturity: pappus slender, barbellulate under the compound lens, 2–6, when more than 2 somewhat unequal.

The decumbent, spreading bases of the otherwise erect stems with their corymbose summits is thoroughly characteristic of this species. Its slender, nearly entire leaves also strongly mark it. Its habitat is in strongly saline ground, on low, clay flats adjacent to lakes and streams. Its root is decidedly woody and probably of several years duration.

Type specimen in the Herbarium, University of Wyoming, no. 4988, by Mr. Elias Nelson, from Sweetwater River, July 27, 1898. Also collected by the writer on Wind River in 1894, and distributed as *C. squarrosa* Dunal, under no. 777.

Grindelia erecta

Biennial, stem single from the enlarged crown of a strong taproot, erect, glabrous throughout, simple below, corymbose-paniculately branched above, 4–8 dm. high: leaves ample, serrate, the teeth short, acute: radical leaves early deciduous the second season, oblanceolate, on slender petioles which equal or exceed the blade, the base of the petiole gradually expanded to a broadish base; the lower cauline similar and also petioled but becoming sessile upward, 6–10 cm. long; uppermost smaller, oblong, sessile by a broad clasping base; heads large, subglobose, usually leafy bracteate; involucral bracts numerous, moderately glutinous, appressed, with slender recurved tips; rays slender, numerous (15–30), 14–18 mm. long: pappus bristles 2–6, mostly 4, slender, minutely but closely barbellulate.

In habit suggesting *G. grandiflora* Hook., of which it is probably the northern representative. It occurs in the cañons among the hills, especially in rocky, sandy dry creek beds.

Type no. 5306, Laramie Hills, Sept. 11, 1898.

Nacrea

Perennial from horizontal rootstocks: stems stoutish, erect, permanently lanate as are also the leaves: heads discoid, congested in a cymose corymb: involucral bracts thin, pearly white, pluriserially imbricated: flowers all hermaphrodite: pappus bristles capillary, thickened at the apex: corolla inserted below the summit of the akene which projects into the tube of the corolla as a short, cylindrical base supporting the style: akene constricted at the point where the corolla is inserted, basal portion (akene proper?) obconical: receptacle plane, alveolate. Name in allusion to the pearly-white involucral bracts.

Nacrea lanata

Rootstocks long, slender, giving rise to numerous fibrous roots: stems singly from the crowns, very strict, leafy, 2–4 dm. high: leaves (like the stem) densely white lanate, thick, rather rigid, erect or somewhat appressed to the stem, sessile or clasping, all nearly similar, narrowly oblong, the rounded-tapering apex sub-acute, 4–8 cm. long, the floral much reduced: heads about 6 mm. high, bracts wanting except for a few foliar ones at the lower pedicels: involucral bracts from ovate to narrowly obovate, the inner ones with a narrowed base: corolla tube slender, the limb slightly expanded, yellow: pappus bristles barbellulate, the unicellular barbules becoming large and obtuse toward the thickened apex of the bristle: akenes (immature in these specimens) roughened with upwardly pointed papillae.

After holding this plant for more than two years without finding a genus for it, I now propose the above to receive it. Its appearance suggests *Anaphalis* but the floral characters exclude it from not only that, but, as at present characterized, from the section Gnaphalieae. I think, however, that the limits of that section must be so enlarged as to admit this genus next to *Anaphalis*.

This plant was collected at a sub-alpine station in the Big Horn mountains, on Little Goose creek, in 1896, July 18. Type specimen in Herbarium University of Wyoming, no. 2391.

Gnaphalium angustifolium

Low annual, branching from the base, the two to several slender stems decumbent-spreading or assurgent, 8–12 cm. long, loosely floccose on the stems and involucres, appressed pubescent on the leaves: leaves numerous, from narrowly to broadly linear, 2–4 cm. long, the floral leaves not reduced and bract-like: the small heads glomerate in the axils, the upper internodes very short forming a congested, leafy cluster: heads moderately involved in wool, about 3 mm. high: involucral bracts lanceolate, acutish, the scarious tips white, brownish below: pappus bristles barbellulate under the compound lens, exceeding the flowers: akene roughened with short, cylindrical papillae.

This falls into the section in which *G. palustre* Nutt. is the conspicuous member but is very distinct from that and the related species. Its spreading habit and its slender, merely soft-pubescent leaves are characteristic. It is a plant of sub-alpine stations, growing in loose, loam soil on the dry sides of recently broken down ravine banks. Type no. 2077, head of Wood's Creek, Medicine Bow Mountains, Aug. 11, 1896. Also collected in Centennial Valley, Aug. 1895, no. 1751.

Juncus repens Michx.—A Morphological and Anatomical Study

By Theo. Holm

(With Plate 363)

Botanical literature already possesses a number of valuable contributions to a knowledge of the Juncaceae from the writings of Buchenau, Engelmann and Kunth, and the laborious works of these authors have furnished botanists not only with diagnoses of a number of species and varieties, but also with data relating to the natural history of this order of plants. The *Monographia Juncacearum* is a work so complete and exact, that it is difficult even for the field-botanist to detect any additional facts that are worthy of being recorded. Therefore, in presenting some observations upon *Juncus repens*, we wish them to be considered only as supplemental to the diagnosis already given, and we desire besides to show some peculiarities in the structure, which we noticed contemporarily with our researches on the North American species of *Fimbristylis.*

In a morphological respect *Juncus repens* affords several points of interest, and occurs under two forms, terrestrial and aquatic, the first representing the most typical growth of the species. Characteristic of both forms is, however, the profuse development of vegetative shoots, especially in the latter, where vegetative propagation predominates. Flowers develop, nevertheless, in both forms, even when the plant is submerged, but the typical floral shoots are to be found only on terrestrial specimens.

Although the rhizome is very short and cespitose, the plant is, nevertheless, able to cover a large area by means of its vegetative shoots borne on prostrate stems with long internodes and by rooting very freely. The structure of these prostrate stems is so much like the flower-bearing ones, that they might be considered as modified floral shoots. They both are distinctly compressed and provided with typical leaves having sheaths and blades, but on the vegetative branches the flowers are replaced by fascicles of shoots. The number of flowers and leafy shoots varies very much and it is not uncommon to find only a few sessile flowers developed among purely vegetative shoots; however, in no instance have we been able to detect flowers that were partly transformed into leaves. The flower-bearing stem consists of several, four or five, stretched internodes, while in the prostrate, vegetative shoots the basal internode is commonly the only one that is visible; specimens in which two or three very distinct internodes are developed are not infrequent however. When two or three long internodes are developed they alternate with a series of short ones each bearing a leaf with axillary shoots. In this manner the species well deserves to be termed as "repeatedly proliferous." None of these vegetative shoots become freed, however, from the mother-plant so as to form new individuals in any other way than by the gradual dying away of the long stem internode. Hence the vegetative propagation is different from what Buchenau has described as characteristic of *Juncus pelocarpus*, where similar small shoots develop in the inflorescence but drop off, producing new individuals.

By examining the flower-bearing stems, we find them similar to the vegetative branches, very strongly compressed but narrower, and they occur as axillary or as terminal; in the first case, they begin with a periphyllon, bicarinate and membranous. The flower-bearing stems are, furthermore, leafy, possessing usually two or three leaves at the base and several some distance above, each supporting a minor inflorescence of a few, nearly sessile flowers, borne on a peduncle of various length. Contrary to our expectation these axillary peduncles are destitute of prophylla at their base even in cases where they have attained a considerable length.

In passing to examine the leaves, our plant demonstrates the singular fact of possessing "distichous leaves with compressed sheaths and broadly linear, flat blades, which turn the one margin towards the stem." Viewed superficially the leaf-blades remind one of the ensiform leaves of *Iris*, but it is readily seen by closer examination that it is merely a twisting of the blade, that has taken place. The flattened stems correspond well with this peculiar structure of the leaf-sheaths and with the partial twist of the blade. It is a structure which we have, furthermore, observed in one of our native species of *Fimbristylis*, *F. autumnalis* R. & S., besides in its southern ally *F. complanata* Link. It seems to be rare in the Juncaceae, but is evidently characteristic of *Juncus obtusatus* Engelm. and of *J. falcatus* E. Mey. judging from the diagnoses in Buchenau's monograph: "lamina interdum oblique ad latus deflexa, inde falcata."

The shoots of *Juncus repens* are hence very strongly flattened throughout, and similar to what we have observed in *Fimbristylis* the leaves are truly distichous, besides turning the blades alternately to right and left, thus all the blades on the one side of the shoot point in an opposite direction to those on the other side. This peculiar position of the leaf-blade in *Juncus repens* has not, however, resulted in acquiring the same internal structure as is characteristic of the two species of *Fimbristylis*, mentioned above, In this respect our *Juncus* agrees nevertheless, better with its nearest relatives among the "*Junci graminifolii*" than with the exceptional case among the Cyperaceae, cited from *Fimbristylis.*

Let us examine the structure in both in order to draw the comparison as precise as possible. A leaf, or rather the half of a leaf-blade of *Juncus repens* (Plate 363, Fig. 1) shows, as far as concerns the epidermis, a dorsiventral blade with the cells somewhat larger on the upper than on the lower face. Moreover the upper epidermis is developed as thin-walled bulliform-cells in the entire width of the blade, in which respect it agrees with both species of *Fimbristylis.* The structure of the mesophyll, however, is very different, being in *Juncus* differentiated into a palisade- and a pneumatic-tissue, while in *Fimbristylis* only the palisade-tissue is developed. The palisade-tissue in *Juncus repens* consists, furthermore, of shorter cells, which are not arranged as regularly radiating around the mestome-bundles as is the case with *Fimbristylis.* Large lacunes traverse the mesophyll in *Juncus* and are interrupted only by obliquely placed diaphragms, accompanied by mestome-anastomoses, small mestome-bundles which pass from the mestome of the larger bundles through the interior of the diaphragms and finally connect with the mestome of another bundle. Similar lacunes are characteristic of Juncaceae, but were not observed in the two species of *Fimbristylis.* Considering the stereome our *Juncus* possesses no sub-epidermal groups of this tissue and there is none in the leaf-margins either. But bordering immediately on the mestome-sheath of the ribs are small stereome-groups to be observed of relatively thin-walled cells, separated from epidermis by mesophyll. In *Fimbristylis* on the other hand the stereome is sub-epidermal and is not in contact with the ribs, these being "pure mestome-bundles." The mestome-bundles (Plate 363, Fig. 3) are surrounded by a colorless, thin-walled parenchyma-sheath, which, on the leptome- and hadrome-side, is interrupted by stereome. Inside of this sheath follows a mestome-sheath of distinctly porose and thick-walled cells, which is perfectly closed and directly surrounds the leptome and hadrome. If we examine the smallest bundles in the same leaf we notice a similar structure, but the mestome-sheath is less conspicuous since only a few of its cells are thick-walled. The drawing (Plate 363, Fig. 4) shows only one slightly thick-walled cell on the hadrome-side and three on the leptome, the other part of the mestome-sheath being thin-walled similar to the parenchyma-sheath outside.

In comparing this structure of the mestome-bundles in our *Juncus* with those of *Fimbristylis*, we notice the total absence of the inner chlorophyll-bearing sheath in *Juncus*. This sheath which we have described and figured in a paper on *Fimbristylis* (*Amer. Jour. of Science*, 1899) seems characteristic of a number of Cyperaceae, but its development does not appear to depend on any certain shape or position of the leaf-blade. In *Juncus repens* the linear leaf-blade, as described above, is held in exactly the same position as that of *Fimbristylis autumnalis*, besides that these plants inhabit much the same localities, yet the leaf-structure is different in both. It is evident that the inner chlorophyll-bearing sheath is characteristic only of certain Cyperaceae, and perhaps only of those in the leaves of which the mesophyll is restricted to palisade sheaths around each individual mestome-bundle.

The leaf of *Juncus repens*, in the terrestrial form, is as we have seen from the above bifacial and shows a rather open structure on account of the wide lacunes. If we examine the submerged form we observe the same structure and a similar position occupied by the leaf-blade, but the lacunes are much wider and the cells of epidermis of the upper face are not much larger than those of the lower.

In regard to the internal structure of the prostrate stem (Plate 363, Fig. 5), this corresponds in most particulars with that of the erect, flower-bearing one. The prostrate stem, however, is broader and somewhat more compressed than the other. The outer cell-wall of epidermis is slightly thickened and the cells are sometimes developed as bulliform, especially outside the lacunes. The bark-parenchyma contains chlorophyll and consists of palisades. Similar to the leaf the mechanical tissue is poorly represented in the stem and occurs only as small groups on both faces of the mestome-bundles, but without being in contact with epidermis, and without forming any closed ring around the inner part of the stem. The mestome-bundles, the large and small ones, form only one peripheral band and their structure corresponds exactly to that of the leaf-bundles. There is a starch-bearing pith, which occupies the inner part of the stem ; it is, together with the bark, interrupted by lacunes, which are somewhat larger in the prostrate, than in the erect, flower-bearing stem. This structure of the stem does not seem different from that of other species of *Juncus*, examined so far, with the exception of the arrangement of the mestome-bundles in two nearly parallel planes on account of the compressed outline. In the cylindric stems the mestome-bundles lie in one concentric band, and the pith occupies the innermost part of the central cylinder, interrupted by a single or several concentric lacunes.

As very little is known of the root-structure in North American Juncaceae, we might state, that there is a persisting hypoderm of only one stratum and that the bark-parenchyma collapses radially with the exception of the innermost two layers, which border on the endodermis. The inner cell-walls of endodermis are very much thickened (Plate 363, Fig. 6) and show a number of layers. The pericambium is thin-walled and very regularly interrupted by the proto-hadrome vessels, there being invariably only two pericambium-cells outside the leptome. A large vessel occupies the center of the root, and is surrounded by two strata of thick-walled conjunctive-tissue. The interruption of the pericambium by the rays of the hadrome, the proto-hadrome vessels, is a character which the Juncaceae, at least a number of species, have in common with several genera of Gramineae, Cyperaceae, Centrolepideae, etc. Besides this the presence of a mestome-sheath is another character which is known to occur in all the Cyperaceae examined, but not in all the Gramineae; according to Schwendener it has not been observed in any of the Andropogoneae or Maydeae, or in several genera of Paniceae. Considered from an anatomical view point

Juncus repens shows no character by which it can be considered generically distinct from any *Juncus*. Neither does its morphological characters taken from the vegetative organs warrant any separation, and the peculiar septifragal dehiscence of its capsule, upon which Desvaux established *Cephaloxys flabellata* is not without intergradating forms within the genus.

BIBLIOGRAPHY.

Buchenau, Franz. Monographià Juncacearum. (Engler's bot. Jarb. Vol. 12. Leipzig. 1890.)

Buchenau, Franz. Kleinere Beiträge zur Naturgeschichte der Juncaceen. (Abhdl. d. naturw. Verein. Bremen. **2**: 392. 1870.)

Desvaux, N. A. Observations sur trois nouveaux genres de la famille des Joncinées. (Journ. de Botanique. **1**: 321. 1808. Paris.)

Engelmann, Georg. A revision of the North American species of *Juncus* with a description of new or imperfectly known species. (Trans. St. Louis Acad. Sci. **2**: 424. 1865.)

Kunth, C. S. Enumeratio plantanum. Stuttgart. **3**: 346. 1841.

Michaux, A. Flora Boreali-Americana. **1**: 191. Paris. 1803.

Schwendener, S. Die Mestomscheiden der Gramineenblätter. (Sitzungsber. d. k. Acad. Wiss. Berlin. 1890: 305.)

Van Tieghem, Ph. Recherches sur la symétrie de structure des plantes vasculaires. (Ann. sc. nat. Botanique. **13**: Paris. 1870.) See also Journal de Botanique. **1**: 305. Paris.

BROOKLAND, D. C., March, 1899.

Explanation of Plate 363.

FIG. 1. Transverse section of half of the leaf-blade of *Juncus repens*. *Ep.*, epidermis of upper face; *L*, lacune; *ep.*, epidermis of lower surface, × 75.

FIG. 2. Stoma from the leaf; *Ep.*, epidermis of lower surface; *Pn.*, pneumatic tissue, × 320.

FIG. 3. Large mestome-bundle from leaf, transverse section; *P.*, palisades; *St.*, stereome; *Pa.*, parenchyma-sheath; *M. S.*, mestome-sheath; *Ep.*, epidermis of lower surface, × 560.

FIG. 4. Small mestome-bundle from leaf, transverse section; letters as in Fig. 3, × 560.

FIG. 5. Stem-part, transverse section; *Ep.*, epidermis; *B.*, bark; *L.*, lacune; *P.*, pith, × 75.

FIG. 6. Transverse section of a part of the root; *B.*, bark; *P.*, pericambium; *P. L.*, proto-leptome; *P. H.*, proto-hadrome; *V.*, vessel; *C. T.*, conjunctive tissue; *End.*, endodermis, × 400.

The Genus Achillea in North America*

BY CHARLES LOUIS POLLARD.

This genus, as now generally understood, consists of from eighty to one hundred species, confined almost entirely to the temperate regions of the Old World. Its critical study has been neglected by American botanists, owing probably to the fact that its representation on this continent was believed to be restricted to two or three species, even these being supposedly introduced from abroad.

The Tournefortian genus *Ptarmica*, which was accepted by De Candolle in the Prodromus, has usually been regarded as scarcely more than a subgenus of *Achillea*. The heads of both are radiate as well as discoid, and in both the achenes are more or less margined. The chief points of distinction lie in the shape of the involucre and the degree of convexity which the receptacle exhibits, while there are few or no habital differences. In this paper, therefore, *Achillea* is accepted as outlined by Hoffman in "Die natürlichen Pflanzenfamilien."

It is an odd coincidence that the type species of both *Ptarmica* and *Euachillea* should occur in North America. *A. Ptarmica* L. is introduced in various portions of the northeastern states, and also in Newfoundland and British Columbia. *A. Millefolium* L., the familiar yarrow, occurs likewise as an introduced weed in meadows, pastures, etc., throughout the Atlantic states from Nova Scotia to Florida, and westward to the Rocky Mountains; it is also occasionally found on the Pacific coast. The fact, however, that the yarrow, of one form or another, extends not only through the West, but northward as well through British Columbia and Alaska, and southward into Mexico, has induced most botanists of the present century to consider the plant a circumpolar type with a well-nigh world-wide distribution. Yet from the earliest pilgrimages of western pioneers, long before the region was penetrated by railroads, *Achillea* has been equally as abundant, and equally at home under conditions that absolutely preclude the assumption that it is not indigenous.* The theory of range-extension explains this circumstance, but fails to take cognizance of the manifest differences of structure existing between eastern and western individuals, and again between western and northern types—differences too marked to find explanations in ordinary circumstances. Moreover, very few modern taxonomists would admit that a single species can occur unchanged throughout so vast a territory as Europe, northern Asia and North America, under such varied conditions of soil, temperature and environment.

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The extensive travels of Nuttall convinced that keen-eyed botanist that the yarrow of the western plateau was not only indigenous, but specifically distinct from the eastern *A. Millefolium.* He therefore published it as *A. lanulosa*, a name which was soon thereafter relegated to synonymy by Hooker. Pursh had previously identified as *A. tomentosa* of Willdenow a plant collected by Lewis in Oregon, the rays of which were stated to be yellow. Nuttall cites *tomentosa* as a synonym, the fact being that Willdenow's name was applied originally by Linnaeus to a species of south Europe known to possess yellow rays. Pursh's error can accordingly be accounted for on the basis of transposed or mistaken labels, scarcely, as Dr. Gray suggested, because the rays of his specimen turned yellow in drying, a phenomenon which, as Professor Greene has remarked to me, never occurs in this genus.

The yarrow found abundantly in Alaska and northern British Columbia was described by Bongard as *A. borealis*, a name which promptly met the same fate as *lanulosa* in Hooker's Flora Boreali-Americana. The species extends southward to the Cascades and Sierras, penetrating even into Mexico, but it is doubtful if it occurs below an altitude of 8000 feet in the southern half of its range. Another species, growing also at high elevations, is found in Mexico. California furnishes two new species, one of the coast, distinguished by its peculiar foliage, which is harsh and scabous, one from the San Joaquin valley, remarkable for its large stature, branching habit, and small rays. These latter forms are manifestly members of the subgenus *Euachillea*, and therefore might logically be reduced to the aggregate *A. Millefolium* by botanists of conservative tendencies; but it is difficult to comprehend why *A. borealis*, which belongs to *Ptarmica* and was placed there by De Candolle should have been transferred to the other division of the genus and combined with the type species thereof.

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* Mr. Coville, in discussing the use made of the yarrow by the Klamath Indians of Oregon, remarks that it is "from the evidence of its occurrence even in very remote and unsettled parts of the plains and from the statements of the Indians, unquestionably native in our Northwest." (Contr. U. S. Nat. Herb. 5: 105. 1897.)

The great mass of our American yarrows may be regarded as belonging to two species. Those of the East seem to be referable to the true European *A. Millefolium*, having the same inflorescence, the same rather diminutive rays and much dissected glabrate foliage. In the Rocky Mountain region there is apparently a commingling and an intergradation with *A. lanulosa*, which although extremely polymorphous, is usually distinguished by its much larger rays and more or less lanate pubescence. I have made a careful dissection of the heads of thirty specimens from widely separated localities in the West, and while there are often differences in the involucral bracts, the measurement of the rays and the appearance of the foliage, these differences cannot be correlated. I am therefore convinced that in the present state of our knowledge it is better to leave the species as an aggregate which we may perhaps regard as already in a process of differentiation. Future collections and observations, particularly with respect to altitudinal distribution, will undoubtedly enable us to make a more satisfactory disposal of these forms.

Specimens of *Achillea* having pink or even rose-red rays are not uncommon, particularly east of the Mississippi. One of these was described by Ventenat, under the name of *A. asplenifolia*, from a garden-grown individual, the seeds of which were brought from Carolina by Bosc; but De Candolle observes that the plant had been well known in European gardens long before Bosc's time. My first impression was that Ventenat's description applied only to the ordinary pink-rayed form of *A. Millefolium;* but having examined his illustration in connection with some very interesting herbarium material, I am now convinced that *A. asplenifolia* is a cultivated plant only, the origin of which is uncertain. The shape and position of the leaf-segments is entirely different from any form of *Millefolium*, and the only specimens matching figure and description that have come within my observation were from cultivated individuals. All wild yarrows with red or pink rays will be found to agree perfectly with the white-flowered forms, and are found growing under similiar conditions, so that they are scarcely worthy of even varietal rank.

I append a key to the species discussed in detail below.

Involucre campanulate, its bracts fuscous-margined; receptacle nearly flat; ray-flowers usually numerous (10–20); achenes rather broadly wing-margined. PTARMICA.
- Leaves bipinnate. 1. *A. borealis.*
- Leaves simple or pinnatifid.
  - Corymbs loosely few-flowered; rays exceeding the bracts. 2. *A. Ptarmica.*
  - Corymbs densely many-flowered; rays shorter than the bracts. 3. *A. multiflora.*

Involucre oblong, the bracts scarcely fuscous-margined; receptacle convex; ray-flowers few (5–10); achenes narrowly margined. EUACHILLEA.
- Rays usually more than 4 mm. in diameter.
  - Leaves with finely divided crowded segments. 4. *A. lanulosa.*
  - Leaves with coarser, distinct segments.
    - Rays white. 5. *A. Californica.*
    - Rays red. 6. *A. asplenifolia.*
- Rays less than 4 mm. in diameter.
  - Plant very tall and branching. 7. *A. gigantea.*
  - Plant simple or slightly branched at summit.
    - Ultimate leaf-divisions filiform. 8. *A. Pecten-Veneris.*
    - Ultimate leaf-divisions linear.
      - Corymbs dense. 9. *A. Millefolium.*
      - Corymbs loose. 10. *A. ligustica.*

1. ACHILLEA BOREALIS BONG. Veg. Ins. Sitch. 149. 1831.

Plant very variable in size, rarely exceeding 4 dm. in height; stem and leaves usually more or less lanate, the latter bipinnate with numerous crowded segments, the ultimate divisions minute and acicular: corymb densely circinate, the heads 4–8 mm. in height with large white or pink rays 5 mm. in diameter: involucral bracts somewhat scarious, with a conspicuous dark fuscous margin: achenes slender, prominently winged.

From Labrador and northern British Columbia to Alaska and adjacent Siberia, southward in the higher mountain ranges of the Pacific slope to Central Mexico. Easily distinguished by its remarkably handsome heads. The lower leaves are sometimes of very large proportions, similar to those of *A. Californica.*

2. A. PTARMICA L. Sp. Pl. 898. 1753.

From Newfoundland and Canada to New England, and Michigan.

3. A. MULTIFLORA Hook. Fl. Bor. Am. **1**: 318. 1834.
Northern British Columbia.

These two species have been generally recognized in our floras. They are well characterized by the simple or merely pinnatifid leaves.

4. ACHILLEA LANULOSA Nutt. Journ. Acad. Nat. Sci. Phila. (1834), 7: 36. 1834.

A. tomentosa Pursh, Fl. Am. Sept. **2**: 563. 1814. Not L.

A. setacea Schwein. in Long's 2d Exp. **2**: 119. 1823. Not Waldst. & Kit.

A. Millefolium γ occidentale DC. Prodr. 6: 24. 1837.

Plant varying greatly in stature, usually from 3–5 dm. high, the whole surface densely lunate, or sometimes nearly glabrate: leaves all finely bipinnatifid, the segments closely approximate, the ultimate divisions minute and acicular, sometimes even spinulose: corymb usually circinate, in age becoming flat-topped: involucral bracts stramineous with greenish keels and brown apical margins: rays usually large (4–6 mm.): achenes elliptical, rather broadly margined.

From British Columbia to the Mexican boundary, eastward to South Dakota, Nebraska and Kansas; possibly also introduced as a ballast weed in the East. An immensely variable species of the plains, growing naturally under a great variety of conditions and in various situations. I have already referred to the difficulty attending any satisfactory disposal of this type. There is less need of additional material than of carefully tabulated field notes giving full altitudinal and climatic data.

5. **Achillea Californica** sp. nov.

Plant robust, inclined to branch at the summit, 6–8 dm. or more high: stem somewhat sulcate, villous with long appressed hairs: leaves very numerous, 6–10 cm. in length, or the basal even exceeding these figures, all bipinnatifid with coarse, rather crowded segments, general outline linear-lanceolate, the pinnae scarcely reduced toward the sessile base; surface of the foliage glabrate, the tips of the ultimate segments harsh and spinulose: corymb very compound, inclined to be flat-topped, the branchlets pubescent: heads 5–6 mm. in height, the involucral bracts stramineous, with greenish keels and slightly fuscous margins; rays large and conspicuous (3–5 mm.): achenes linear narrowly margined.

Type in the U. S. National Herbarium (no. 238094) collected by Mr. H. W. Henshaw on the Californian sea coast at Santa Ysabel, May, 1893. The same plant is found at other points on the coast line, notably at Santa Barbara. In many respects this species exhibits the characters of a true halophyte.

6. ACHILLEA ASPLENIFOLIA Vent. Hort. Cels. *t. 95.* 1800

A. rosea Desf. Tabl. Hort. Par. ed. **1**: 105. 1804.

Stem villous, usually simple: leaves glabrate, regularly bipinnate or even tripinnatifid, the rachis slightly margined: segments divaricately spreading, their divisions more or less lobed, linear and acute: petiole with dilated margined base, the pinnae little reduced below: corymb dense: involucral scales very sparsely hairy, with green centers and scarious, ciliate margins, often somewhat rufous at apex: rays 2–4 mm. in diameter, rose-purple: achenes linear, very slightly winged.

Occurring only in cultivation, the original habitat unknown.

There are two specimens of this remarkable species in the National Herbarium; one collected at the Botanical Garden by Schott, and one obtained from a garden at Oneida, N. Y., by Mr. William R. Maxon. I have also noted a plant in the Harvard Herbarium, collected by Sartwell at Penn Yan, N. Y., which, although the label does not indicate it, was doubtless from a cultivated individual. It is frequent in European gardens, thus giving color to the supposition that it originated as a horticultural variety; at present, however, it is abundantly distinct from any rose-rayed form of the wild yarrow.

7. **Achillea gigantea** sp. nov.

Plant robust and much branched, nearly 1 m. in height. the main stem 1 cm. in diameter, sulcate and densely clothed like the foliage, with long villous hairs; leaves on the main stem 8–10 cm. long, those on the branches 4 cm. long, linear lanceolate in outline, biipnnatifid with coarse closely approximate pinnae, these scarcely at all reduced toward the sessile, almost auricled base: ultimate segments from linear to ovate, usually obtuse: corymb many-branched, long-stalked, circinate, the branchlets densely pubescent: heads 5–6 mm. in height, the involucral bracts carinate, greenish throughout: rays very small, scarcely exceeding 1 mm: achene elliptical, obscurely winged: style but little exserted.

Type in the U. S. National Herbarium (no. 279104) collected by Dr. Edward Palmer near Tulare Lake, Tulare Co., California, August, 1892. The specimen includes a portion of the main stem with two side branches, and the dimensions given above are those of the entire plant as nearly as Dr. Palmer recollects them. I have observed no other specimen of this remarkable *Achillea*.

8. **Achillea Pecten-Veneris** sp. nov.

Plant of slender habit, 4 dm. or more in height, simple, the stem markedly sulcate, loosely pubescent or villous; leaves 8–12 cm. in length, oblanceolate in general outline, regularly and finely bipinnatifid or bipinnate, the segments as well as the ultimate divisions filiform, gradually reduced toward the base of the rachis; surface of the foliage obscurely pubescent with scattered hairs, the somewhat clasping base of the petiole usually villous: corymb many-branched, inclined to be flat-topped, the branches and branchlets puberulent: heads 4–5 mm. in height, the bracts of the involucre stramineous, carinate, each with a dorsal greenish stripe: rays white, scarcely exceeding 2 mm. in length: achenes narrowly elliptical, rather more broadly margined than in other members of the subgenus: style much exserted.

Type in the herbarium of Harvard University, collected by A. Duges at Guanajuato, Mexico (no. 421). Mr. Seaton's no. 354, in the Herbarium of Columbia University, collected on Mt. Orizaba at an altitude of 8000 feet, is also to be referred here.*

9. ACHILLEA MILLEFOLIUM L. Sp. Pl. 899. 1753.

Plant of variable stature, usually 3–6 dm. high, sparsely villous or glabrate; leaves of thin texture, evenly bipinnatifid, the petiole with dilated clasping base; segments not closely approximated, the ultimate divisions linear: corymb generally flat-topped, very compound, the branchlets glabrate: involucral bracts pale stramineous with greenish keels: rays usually small (2–3 mm.), white or pink: achenes linear, scarcely margined.

Newfoundland and Canada to Florida, westward to the foothills of the Rocky Mountains. Specimens selected at random from various parts of this range were found to agree perfectly with European material. It should be noted here that although Linnaeus cites no figure for his type, there are numerous illustrations of *A. Millefolium* among the works of older authors, all of which point to the same plant.

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* Since writing the above, I have been informed by Dr. J. N. Rose that this species is exceedingly abundant throughout Central Mexico, where he is now collecting.

10. ACHILLEA LIGUSTICA All. Fl. Pedem. **1**: 181, *t. 52. f. 2.* 1785.

Plant robust and branching, pubescent or puberulent: leaves coarsely bipinnatifid, the rachis broadly margined: segments comparatively few, ovate or oblong in outline, irregularly incised: corymb rather slender, flat-topped: involucral bracts greenish, carinate: rays white, 2–3 mm. in diameter; achenes linear, wingless.

This plant must be added to our list of European waifs, two specimens having been collected at Onteora, N. Y., in 1891 by Miss Anna Murray Vail. The plant has also been collected on the Massachusetts coast.

In conclusion, I wish to express my grateful acknowledgements to Dr. N. L. Britton, Prof. L. M. Underwood and Dr. B. L. Robinson for the loan of material, and to Prof. Edward L. Greene for the privilege of using his invaluable library. To Mr. William R. Maxon, of the National Museum, I am also indebted for assistance in many critical comparisons and verifications.

A little-known Mildew of the Apple

By A. J. Grout

(With Plate 364)

Late in the antumn of 1892 (November) a mildew was observed on a few belated leaves clinging to the adventitious shoots from the stump of a young apple tree in Newfane, Vt. The shoots were gathered and the leaves closely examined for perithecia, but none could be found. An accidental examination of the twigs showed that the mycelium had spread over the upper portions and here and there were darker spots covered with more closely matted mycelium. Under the microscope these spots were found to contain abundant perithecia, like those figured in plate 364, figs. 1 and 2. At that time I found no one in New England who knew this mildew. It was, however, described in Ellis and Everhart's North American Pyrenomycetes (then recently issued) as *Sphaerotheca mali* (Duby) Burrill. Prof. Burrill there remarked that he had not had access to any European material of this fungus that was at all satisfactory, but from the description and the fact that it was scarcely possible that the introduced *Pyrus Malus* should have an exclusively American parasite of this kind, he concluded that the American plant was the one described as *Erysiphe mali* Duby, Botan. Gall. **1**: 869. 1830.

A careful examination of the exsiccati in the Harvard and Columbia herbaria, including the Ellis herbarium, failed to bring to light any European material of *Erysiphe mali* Duby which contained perithecia in condition to be of any use. The European exsiccati contained leaves only, while the perithecia in the American plant were invariably found on the young twigs.

In November, 1898, Dr. Magnus, of Berlin, published in the Berichte der Deutschen botanischen Gesellschaft a historical and descriptive account "Ueber einen in Südtirol aufgetretenen Melthau des Apfels" in which Professor Magnus completely confirms Professor Burrill's conclusions. As his article and plate will be accessible to comparatively few in America, this article and an entirely new drawing by Prof. F. E. Lloyd, of the Teachers College, New York City, have been prepared to interest eastern collectors in this little known fungus.

In 1895 this mildew was again collected in Newfane, on adventitious shoots from a tree growing about fifty rods from the place of its first collection. This was distributed as no. 926 of Ellis & Everhart's Fungi Columbiani. It had previously been distributed as no. 3213 in their N. Am. Fungi, collected in Ames, Iowa, by Prof. Pammel. In the Ellis herbarium it is further represented from Missouri (Demetrio) and Kansas (Kellerman and Swingle). Prof. Burrill remarks of its distribution. "Not apparently very frequent but exceedingly abundant at times. Mississippi Valley and probably eastward."

It seems probable that this mildew is not uncommon but is rarely collected because its perithecia are on the shoots instead of the leaves and also because the perithecia do not mature until very late in autumn when no one thinks of collecting mildews. The above mentioned peculiarities belong to the European plant also according to Professor Magnus and probably furnish the explanation of the poor European exsiccati and the comparative ignorance of the plant among European botanists.

SPHAEROTHECA MALI (Duby) Burrill; Ellis & Everhart, N. Am. Pyreno. 7. 1892.

Mycelium growing on young shoots and upper side of leaves; perithecia seldom or never found on the leaves. Mycelium on the leaves thin; fruiting mycelium more dense. Perithecia densely aggregated in small dark brown patches, 75–95 μ, reticulations evident, appearing to be raised but in profile seen to be sunken; appendages 4–12, clustered at the summit of the perithecia, septate, colored nearly the whole length, frequently nodulosely swollen near the tips, length 4–8 times the diameter of the perithecium, easily detached; perithecia bearing on the under side an abundance of short irregular rhizoidal appendages the nature of which is doubtful. Asci single, almost globose, 42–48 × 50–66 μ. Spores 8, elliptical, 13–21 μ.

On the upper parts of young twigs of *Pyrus Malus*, especially in nurseries of young trees, and on suckers or adventitious shoots from old branches.

The stiff rigid appendages are totally unlike the appendages of any other *Sphaerotheca* known to me and seem to me to constitute as good a generic distinction as the number of asci in a perithecium.

DESCRIPTION OF PLATE 364.

Figs. 1 and 2, camera lucida drawings of the perithecia, $\frac{45}{1}$ and $\frac{812}{1}$, respectively; 3, 4, 5, 7 and 8, tips of appendages; 6, basal part of appendage to show the proportions of cells; 9, ends of two adjoining cells; 10, junction of basal and neighboring cells; 11, ascus and spores, $\frac{312}{1}$; 12, walls of exosporic cells-reticulum; 13 and 14, rhizoidal appendages, $\frac{600}{1}$.

Nomenclatural Notes.—II

By John Hendley Barnhart

1. *Ilysanthes gratioloides* (L.) Benth. The first edition of Linnaeus' Species Plantarum is no longer regarded as favorable territory for the nomenclatural explorer, yet the fact seems to have escaped entirely the attention of our American botanists that the *Gratiola dubia* of that work is identical with *Capraria gratioloides* of the second edition. The name of this species should be:

Ilysanthes dubia (L.)

Gratiola dubia L. Sp. Pl. 17. 1753.
Capraria gratioloides L. Sp. Pl. Ed. 2, 876. 1763.
Ilysanthes gratioloides Benth.; DC. Prodr. **10**: 419. 1846.

2. *Monotropsis* Schwein. No one appears to have noted the fact that Elliott, in publishing Schweinitz' name *Monotropsis*, not only expresses a desire that the genus should be called *Schweinitzia*, but does so in such a way that the latter name enjoys the priority of position. As *Schweinitzia* is accompanied by the description of *Monotropsis* and its species *M. odorata*, its due publication seems unquestionable. It is strange that Elliott, who proposed *Schweinitzia*, and Nuttall, who adopted it in the following year, both failed to combine any specific name with it. This omission, however, was promptly rectified by Rafinesque. The synonymy of this genus thus stands as follows:

SCHWEINITZIA Ell. Bot. S. C. & Ga. **1**: 478. 1817
[MONOTROPSIS Schwein.; Ell. Bot. S. C. & Ga. **1**: 478. 1817.]
SCHWEINITZIA ODORATA (Ell.) Raf. Am. Mo. Mag. **3**: 99. 1818
Monotropsis odorata Ell. Bot. S. C. & Ga. **1**: 479. 1817.
Schweinitzia Caroliniana Don, Gard. Dict. **3**: 867. 1834.

SCHWEINITZIA REYNOLDSIAE A. Gray, Proc. Am. Acad. **20**: 301. 1884.

Monotropsis Reynoldsiae Heller, Cat. N. Am. Pl. 5. 1898.

3. *Trientalis Americana.* From all recent botanical works it would appear as if this species were first distinguished from *Trien-*

talis Europaea by Pursh, in 1814. It was actually separated as a variety by Persoon, in 1805, and as a distinct species by Rafinesque in 1808. Its synonomy should therefore appear:

TRIENTALIS AMERICANA (Pers.) Pursh, Fl. Am. Sept. 254. 1814
Trientalis Europaea Americana Pers. Syn. **1**: 402. 1805.
Trientalis borealis Raf. Med. Rep. II. **5**: 354. 1808.
Trientalis Europaea angustifolia Torr. Fl. N. U. S. **1**: 383. Je. 1824.

4. *Elatinoides* Wettst. This name, proposed in 1891 in Engler & Prantl's great work, is obviously identical with Dumortier's *Kickxia*, published in 1827 (at which time this latter name was unpreoccupied, although since used as *Kixia* or *Kickxia*, for an entirely different genus). When the writer first noticed this in his own copy of the Florula Belgia, he thought that it might have been overlooked, but it is cited in De Candolle's Prodromus, Pfeiffer's Nomenclator and Synonyma, and the Index Kewensis; in fact. about everywhere where it would be looked for. Our two species, both introduced, are the ones which constituted the genus as originally published by Dumortier.

KICKXIA Dumort. Fl. Belg. 35. 1827
[ELATINE Hill, Brit. Herb. 113. 1756. Not L. 1753.]
[LINARIA § ELATINOIDES Chav. Mon. Antirrh. 103. 1833.]
[ELATINOIDES Wettst.; E. & P. Nat. Pfl. **4**^{3b}: 58. 1891.]

KICKXIA ELATINE (L.) Dumort. Fl. Belg. 35. 1827
Antirrhinum Elatine L. Sp. Pl. 612. 1753.
Linaria Elatine Mill. Gard. Dict. Ed. 8, no. 16. 1768.
Elatine hastata Moench, Meth. 524. 1794.
Elatinoides Elatine Wettst.; E. & P. Nat. Pfl. **4**^{3b}: 58. 1891.

KICKXIA SPURIA (L.) Dumort. Fl. Belg. 35. 1827
Antirrhinum spurium L. Sp. Pl. 613. 1753.
Linaria spuria Mill. Gard. Dict. Ed. 8, no. 15. 1768.
Elatine ovata Moench, Meth. Suppl. 171. 1802.
Elatinoides spuria Wettst.; E. & P. Nat. Pl. **4**^{3b}: 58. 1891.

5. *Wulfenia Houghtoniana* (Benth.) Greene. This plant was described by Bentham as a new species in 1846, under the name *Synthyris Houghtoniana*. It is perfectly clear, however, that this is the same plant intended by Eaton, six years earlier, in his de-

scription of *Gymnandra Bullii.* Strangely enough this name has been overlooked or ignored by all subsequent writers, and is not mentioned by any of them even as a synonym. The nomenclatural history of this species thus appears to be :

Wulfenia Bullii (Eat.)

Gymnandra Bullii Eat.; Eat. & Wr. N. Am. Bot. 259. 1840.

Synthyris Houghtoniana Benth.; DC. Prodr. **10** : 454. 1846.

Wulfenia Houghtoniana Greene, Erythea **2** : 83. 1894.

6. *Lonicera ciliata* Muhl. This is undoubtedly the *L. Canadensis* of Marshall, although the latter does not seem to have been cited by any recent writer.

LONICERA CANADENSIS Marsh. Arb. Am. 81. 1785

Lonicera ciliata Muhl. Cat. 23. 1813.

7. *Cuscuta glomerata* Choisy. In Britton & Brown's Illustrated Flora, Choisy's name has been replaced by *C. paradoxa* Raf. (1820). But this was not Rafinesque's first name for the plant. In reporting his "Western Discoveries" in the American Monthly Magazine, in 1818, he described it under the name *C. aphylla ;* a somewhat inappropriate name, considering that all the species of *Cuscuta* are practically leafless, and this is doubtless why Rafinesque afterward changed it. By the description, "stems evanescent," "flowers in large and thick glomerules round the stems of other plants," and especially the "two long filiform styles"; by the habit, "it surrounds the stems of many singenesous [*i. e.*, syngenesious] plants ;" and by the range "in the prairies of Indiana and Illinois, near the Wabash, and in the barrens of Kentucky," this *Cuscuta aphylla* is as unmistakable in its identity as any plant ever described by Rafinesque. Its synonymy is :

CUSCUTA APHYLLA Raf. Am. Mo. Mag. **4** : 40. N. 1818

Cuscuta paradoxa Raf. Ann. Nat. 13. 1820.

Cuscuta glomerata Choisy, Mem. Soc. Gren. **9** : 184, *pl. 4. f. 1.* 1841.

Lepidanche compositarum Engelm. Am. Jour. Sci. **43** : 344, *pl. 6. f. 30–35.* 1842.

8. *Generic names wrongly credited.* It would be well if botanists would exercise a little more care in referring generic names

to their correct source. This is true especially of pre-Linnaean names "revived" since 1753. Even in Britton & Brown's Illustrated Flora we have *Abies*, *Malus*, and *Linaria* referred to Jussieu's Genera Plantarum (1789), while species under each are credited to Miller's Gardener's Dictionary (Ed. 8, 1768); "*Melilotus*, Juss. 1789," but "*Melilotus officinalis* Lam. 1778;" "*Helianthemum* Pers. 1807," but two species credited to Michaux (1803); and other similar cases.

A much-neglected work, perhaps because so rare, is Hill's British Herbal, published in 1756. Among the pre-Linnaean names here used, we find the following, usually referred to a much later date: *Abies*, *Alnus*, *Castanea*, *Cymbalaria*, *Fagopyrum*, *Hypopitys*, *Linaria*, *Malus*, *Melilotus*, *Ostrya* and *Ulmaria*. The generic and specific descriptions in this work are clear and accurate. It is true that the binominal system of Linnaeus is not adopted, but this is also true of P. Browne's History of Jamaica, Haller's Historia Stirpium Helvetiae, the first edition of Scopoli's Flora Carniolica, Necker's Elementa Botanica, and many other works which are constantly cited for generic names. Most of the names in this book, which might otherwise replace those now in use, are compound, and likely to be avoided on that account, although such names as *Filix-mas*, *Bursa-pastoris*, and *Dens-leonis* in themselves appear to the writer to be no more objectionable than *Mesembryanthemum*, *Dactyloctenium*, and *Kosteletzkya*, and far preferable to the specific name *Carolinae-septentrionalis* recently perpetrated by a Southern contemporary.

9. *Dates of Publication.* In the recently issued Part 3^2 of his Revisio Generum Plantarum, Dr. Kuntze maintains[*] that Barton's Compendium Florae Philadephicae was issued in January, 1818, and is the original place of publication of some of Nuttall's names, such as *Epifagus*. In fact, the title of Barton's Compendium was not deposited to secure copyright until July 9, 1818; the preface is dated July 11, 1818; the true date of the publication must have been later than the former. Nuttall's Genera was published later than the middle of May, 1818; possibly later than Barton's Compendium (as suggested by the writer in a former paper[†]), but probably not.

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[*] Kuntze, Rev. Gen. Pl. 3^2: 160. 1898.

[†] Bull. Torr. Bot. Club, **24**: 409. 1897.

As Dr. Kuntze starts with wrong premises, it is but natural that he should reach incorrect conclusions. He indicates very plainly how he came to be led astray in this matter, for he says: "Already in February, 1818, Rafinesque corrected Nuttallian names, *e. g.*, *Leptamnium* Raf., proposed for *Epifagus* Nutt." Evidently he is not familiar with the pages of the American Monthly Magazine. The paper published by Rafinesque in February, 1818, is the second of two devoted to the criticism of Pursh's Flora (1814). *Leptamnium* was not proposed as a substitute for *Epifagus* Nutt. It was published as follows: "*Orobanche Virginiana* and *O. uniflora*, must form two peculiar genera, *Leptamnium* and *Thalesia*, Raf." In the American Monthly Magazine Rafinesque made no mention of any of Nuttall's names until January, 1819, when he indulged in an extended criticism of Nuttall's Genera.

TARRYTOWN-ON-HUDSON, November, 1898.

The Influence of wet Weather upon parasitic Fungi*

BY BYRON D. HALSTED

April and May of the present year were interesting to both the meteorologist and mycologist. There is doubtless some vital connection between the weather and the development of parasitic fungi, and it is the province of this paper to record some observations, with the hope that it may help to furnish data of value both to science and crop growing.

The following facts are gathered from the New Jersey Weather Service. For April the average precipitation for the whole state was 3.77 inches, or .40 inch above the normal. It rained on 12 days, 22 were cloudy and 8 were clear. In short, it was an overcast, but not a very wet month.

For May the average precipitation was 7.00 inches, or 2.82 inches above the normal. It rained on 17 days, and there were only 7 clear days out of the 31. In the language of the report, "The precipitation during the month of May, 1898, will long be remembered as one of the greatest on record."

The following are some of the notes upon fungi for the spring of the present year:

The hollyhock rust, *Puccinia malvacearum* Mont., has been much more abundant and destructive this season than ever before. It came into spore production early and ruined many beds of plants. Leaves of the ordinary size sometimes had hundreds of spore sori that quickly became coated over with the promycelia and sporidia.

Early in May the cedar apples in the southern part of the state were abundant and resembled modern chrysanthemums in their large size. Many trees were seen where *Gynosporangium macropus* Link., covered the branches and main stem of the trees (*Juniperus Virginiana* L.) with the gelatinous horns.

Upon May 28 it was reported to me by a local botanist that the Azalea apples (*Exobasidium azaliae* Peck.) were unusually abundant upon *Azalia nudiflora* (L.) and upon the same date the writer inspected many paeonia plants that while pushing their flower stalks had all the inner leaves of the bushes overrun and blighted by a dense growth of *Botrytis vulgaris* Fr. It was a clear case of the fungus flourishing as a parasite upon the spring herbage.

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* Read before Section G. of the A. A. A. S. at its Boston meeting, August 23, 1898.

Among wild plants the large succulent foliage of the mandrake proved especially susceptible. As early as May 15th a *Ramularia* was found producing large brown patches, and soon after the rust (*Puccinia podophyllii* Schr.) appeared in great abundance, and within two weeks scarcely a plant could be found with the leaves not covered with the telentospore form of the rust.

A very large per cent. of the plants of *Claytonia Virginica* L. were ruined by *Aecidium Mariae-Wilsoni* Clint., and the smut (*Ustilago ornithogali* Schm.) ravaged *Erythronium Virginicum* Sm.

Some plants of *Onagra biennis* (L.) were affected with *Synchytrium fulgens* Schr., covering leaves and stem alike completely. The same was true of *Aecidium epilobii* DC. The rust *Puccinia curtipes* Howe on *Saxifraga Virginiana* Michx. was very abundant and *Plasmopara geranii* (Pk.), and *Peronospora parasitica* (Pers.) were largely in evidence upon their respective hosts. *Cystopus candidus* was very common on shepherds' purse, while *Cerastium vulgatum* was literally overrun by *Isariopsis pusilla* Fr.

In the fruit garden the blackberries suffered unusually from the rust, *Caeoma nitens* Schw., in May and June; *Monilia fructigena* secured the cherry crop, and in the grain fields the rye showed much *Urocystis occulta* Wallr., and a still larger percentage of wheat was destroyed by *Ustilago tritici* P., while some fields of oats were ruined by *Ustilago avenae* (Pers.).

In the orchards the members of the genus *Exoascus* have been remarkably abundant, upon the cherry trees; and never before, to my knowledge, has there been any such wide-spread outbreak of peach curl (*Exoascus deformans* (Berk.)) in this country as during the spring of 1898. In some orchards every leaf was more or less affected, and young trees recently set were similarly diseased. In the "Rural New Yorker," under date of June 18th, there is an editorial upon the subject in which it is stated that "The peach orchards have never before received such a visitation of curl as this year."

It may be assumed that the weather of one season affects the vegetation of the next, and it should be borne in mind that the summer of 1897 was a very wet one. In the six months of the growing season, namely: April, May, June, July, August and September, all except September had a rainfall above the average. In short, in place of the 25.01 inches for the normal there were 30.31 inches, more than a third (11.42 inches) of which fell in July. This is the heaviest rainfall for any month during the ten years that the writer has been connected with the New Jersey Experiment Station. The season that was most nearly like that of last year is that of 1889, in which five out of the six months of the growing season were above the normal in rainfall and the total was 36.87 inches. It was during this season that the precipitation for July was 10.19 inches, giving the month the second rank for rainfall for the past nine years.

As 1889 and 1897 were the two wet years of the last ten, and agree in having the heaviest precipitation during July, it will be to our purpose to note here some observations upon fungi recorded for those two years and return later to any consideration of the relation of the weather of one season to the mycological developments in the next.

In 1889 the writer spent a large fraction of his time in the study of crops by personal visitation throughout the state. It being his first year at the Experiment Station, there was no means of making any comparisons, but the mid-summer was characterized by the extensive development of parasitic fungi of various species. There was, for example, a phenomenal outbreak of the potato rot and both *Phytophthora infestans* De By. and the bacterial disease, working alone or together, carried off the main portion of the crop. Large growers throughout whole sections of the country did not harvest their potatoes, while others dug and placed them in heaps where they rotted.

The mildew of the lima bean, *Phytophthora phaseoli* Thax., was described by Dr. Thaxter in 1889 and figured in the Annual Report of the Connecticut Experiment Station for that year, where it is stated that it was first observed in September and in some cases the bean crop was greatly injured. Particular stress is laid upon the year of discovery, and its abundance because in the hree months of July, August and September for 1889 the total rainfall for New Jersey was 23.73 inches, or nearly ten inches above the average, and presumably it was as wet in Connecticut.

Of other fungi the writer calls to mind the destruction of the grape crop by Black Rot (*Physalospora Bidwellii* (Ell.)) and not trusting to memory the following is taken from the Experiment Station report for 1889 "It is no exaggeration to say that in some parts of the State it (grape crop) has been a complete failure. For example, * * * at Egg Harbor recently the writer was informed that in all that section, famous not only for the number, but for the fine quality of its grapes, the vineyards had yielded no marketable fruit."

It was the same year that the writer found for the first time *Plasmopora Cubensis* (B. & C.) in abundance upon pumpkin, squash and field cucumber, and he will never forget the impression made upon him of a large hillside apple orchard having an orange color from one end to the other due to the roestelia of the *Gymnosporangium macropus* that infested nearly every leaf and many of the twigs and fruits.

There is no question but that 1889 was a remarkable year for the abundance of rain and also for the prevalence of destructive fungi.

Coming now to 1897 it is recorded that the same potato sections were visited as in 1889 and the same story of destructive decay was listened to as related by the disappointed potato growers. *Phytophthora infestans* was so abundant in some fields that scarcely a leaf escaped its attack.

In a similar manner the bean *Phytophthora* was particularly destructive in 1897 and the list is a long one of those fungi that were pestiferous. Through a large part of the State the grapes rotted so badly that they were in some places removed by tons and burned as a check upon future ravages.

There is no question in the minds of the crop growers, but that 1897 was a year remarkable for its losses due to the ravages of fungi.

The two years we have been considering, namely, 1889 and 1897, are remarkable meteorologically for the heavy precipitation in July and for the fact that the whole growing season was wet.

In 1890 it is seen from the record there were four out of the six months above the normal, but the excess in each case was small and the total rainfall 25.75 was but little above the average: 25.01. The record shows to quote from the report for that year that "This has been a year of trouble with potatoes * * * decays of various sorts have been destructive * * * Farmers were plowing the ground for wheat paying no attention to the large crop of decayed potatoes in the soil."

It was the season that the bacterial disease came prominently into notice in New Jersey. It is in cases like this one of 1890 that one needs to remember that the fungous troubles of one season may be entailed upon the next should the conditions be at all favorable. There was a rainfall above the average for all the months except April and May and while not excessive this season followed one phenomenal for a wet July and the prevalence of fungi.

The years 1891 and 1892 were dry ones in which there was no outbreak of fungous troubles. The same is true of 1895 and 1896.

The year 1894 while not a particularly wet one is peculiar for the heavy fall of rain in May, 7.72 inches, and in September 7.46, amounts about doubling the average for those months, while the other four months were below the normal. It was a dry summer.

From the mycological standpoint the year was remarkable for the most wide-spread and destructive attack of fire blight that the writer has ever seen. Personal visitations to various fruit-growing sections of the State confirmed the written reports received that scarcely an apple or quince tree had escaped and a large percentage of pear orchards were injured.

Rainfall does not express all the meteorological conditions that need to be taken into consideration and in this connection it should be stated that the precipitation from May 1st to June 7th was double that of the average and from June 7th to 17th there were ten days following directly upon the heavy rains when the temperature in the day was unusually high with remarkably cool nights alternating. In short there was a long period of cloudy, rainy weather followed by a superheated period as above mentioned.

It was in the wake of these phenomenal meteorological changes that the blight came. This was the beginning of an entire loss of faith in the "iron clad" nature of the "Keiffer" pear and the year when many fruit growers determined that the "Smith's cider" apple was a variety no longer profitable simply because of its susceptibility to the blight. Orchards of pears were so badly crippled in 1894 that their recovery has been slow where ruin was not complete.

Turning to the printed notes for other fruits for the same year it is found under the Cherry leaf spot fungus (*Cylindrosporium padi* Karst.) that "never before has the writer seen such an abundance of this destructive parasite. It was impossible to find a single tree that was not more or less affected by this fungus and in hundreds of instances whole orchards were strikingly reddened by it."

Peaches were spotting badly with the *Cladosporium carpophilum* Thüm., as early as June 10th and particularly abundant upon the foliage, giving it a very distressing appearance.

The heavy September rains came late in the growing season and did not seem to have any marked effect upon the health of the ordinary crop plants for that autumn.

The next season, however, was one in which blight prevailed, but to a less extent than in 1894. The rains were somewhat excessive in April, 4.88 inches, followed by five months that in rainfall were below the average.

In connection with a bacterial disease like the fire blight, one is not yet able to decide how much of the progress of the disease may be ascribed to the previous rainy autumn and the wet early spring and we must not forget that the year before was remarkable for blight, thereby leaving a vast stock of germs on hand for future development.

It remains to consider in brief the year 1896, which, as a whole, was a dry one with a rainy June and July. It was during this time that the asparagus rust *Puccinia asparagi* DC., made its appearance in the Eastern United States to an alarming extent. The records show that the same disease reappeared in 1897 in even greater abundance, at least in New Jersey, and the wet season closed with the asparagus beds literally brown from the ravages of the rust.

It is too soon to predict in more than in a general way the outcome of a crop when the main features of the weather are given.

(More clear than any other are the possibilities of forecasting for the downy mildews.) The potato *Phytopthora* is quite likely to come when there is a wet June, July and August, as shown by the experience of 1889 and 1897.

The observed facts in connection with *Peronospora* and a dry season may not be amiss. During 1887, while in Iowa, it was recorded that from March to August there was only 8.32 inches of rainfall, followed by nearly ten inches in September. A study was made of the downy mildews and the following note was recorded in a bulletin of the Botanical Department of the Iowa Agricultural College for the year: "These observed facts show that with the Peronosporeae there is no doubt that the species are best suited to a moist season. The members of the genus *Peronospora* have in no instance been so abundant during the last two dry years as before the drought came. There was a decided decrease of the mildews the past year until the September rains came, and after that a few weeks of warm weather followed, during which seedlings of various kinds sprung up, and on these, in some instances, Peronosporae made their appearance. In general the mildews were found in early spring and after this, through the long dry summer, in limited quantities, upon plants growing in moist places along streams and edges of pools."

The genus *Cystopus* seems less influenced by drought, but as a rule there was less of the species and the infested specimens were those best situated for obtaining moisture. In all cases where Peronosporeae flourished they were upon succulent hosts, and even with these there were probably less growth of parasites but greater manifestation of disease due to lack of vitality in the hosts. These instances, therefore, form no exception to the general rule, that dry weather is not advantageous for the development of the Peronosporeae. The apple rust and the black rot of the grape come in the same category with the potato rot.

With the twig blights due to bacteria that spread most largely in early summer from flower to flower by means of bees or to the tender opening leaf buds the case is different. This would seem to be favored by a wet early spring as evidenced by the remarkable outbreak in 1894, when, in May, 7.72 inches of rain fell, the third largest monthly precipitation during the nine years.

There are no extensive data in connection with the asparagus rust as it was unknown here until 1896, but during the two years it has appeared the midsummers have been wet, but only slightly so in 1896 and not at all comparable with 1889 and 1897, when the July rains attained to 10.19 and 11.42 inches respectively and potato rot and bean *Phytophthora* prevailed.

The observations thus far made are not sufficient for any generalization, but the evidence points to the opinion that a wet April and May will prepare the way for an abundance of fungi that come in early June. This will include particularly the bacterial troubles of the orchard and fruit garden.

A wet June and July is apt to bring a failure, whole or partial, of the potato crop almost as certainly as the decay of stone fruits with *Monilia*. And should August be rainy in addition the chances of a grape crop become very small.

As has been suggested, the rain gauge does not tell the whole story. There may be cloudy weather without rainfall and great humidity without precipitation. Therefore guiding principles are far to seek so long as the several meteorological factors admit of infinite combinations.

The problem as it lies before us does not lend itself easily to the experimental method, simply because climate cannot be varied at will and applied locally as the student may desire. Something may be done in supplying water artificially in the various ways of modern irrigation; but this does not affect the atmosphere that plays in far reaching breezes, blowing for days at a time and from long distances. However, something has been attempted in this direction at the New Jersey Experiment Station and the following is gathered from the notes upon the subject. With turnips the irrigation experiments in 1896 showed that water may be applied to advantage in a dry season, "provided the ground was not infested with club-root, in which case the additional water only increased the virulence of the root malady."

The same printed report shows that for tomatoes the larger amount of fruit decay is upon the irrigated land, partly due to their being a larger percentage of those that cracked and became worthless. The irrigated plants presented a somewhat better appearance than those not receiving water, because there was more new growth; but not from any lack of the blight *Septoria lycopersici* Speg.

With the beans the report reads "The anthracnose *Colletotrichum lagenarum* (Pass.) was more than twice as abundant upon the irrigate than upon the check belt, but with the bacterial disease the amounts were reversed." In another field where beans had not been previously grown the irrigated land gave nearly double the anthracnose found upon the check and here also the bacteriosis was less than where the plants were not watered.

With potatoes and beets the results were negative, that is, there was no marked difference between the irrigated and non-irrigated in the amount of scab or leaf blights. With celery there was considerable gain in crop and an apparent decrease of the blight.

Another line of experimentation upon the general subject of weather versus fungus growth is by shading the plants partially as if in imitation of an overcast sky. During 1897 several garden crops were partially shaded by placing lath frames over the plants and cutting off one-half of the direct sun.

No striking results were obtained concerning the development of fungi and as the experiments are still running no report will be made for them here.

RUTGERS COLLEGE.

Proceedings of the Club

TUESDAY EVENING, APRIL 11, 1899

President Brown in the chair, 23 present.

An invitation was extended to Club members to be present at the tea given by the Barnard Botanical Club from 4 to 6 P. M., April 28th, at Barnard Botanical Laboratory. On motion, the club sent its acceptance with thanks, through the secretary.

Another invitation was presented, from the Washington Botanical Club, and seeking a joint Decoration Day excursion at Washington. On account of distance and the date of the holiday in the week, it was not deemed possible to accept as a club, but it was recommended that those attend as individuals whose engagements may permit. On motion, the thanks of the club were transmitted through the secretary.

Another invitation was discussed favorably as within practicable distance, being that of the Philadelphia Botanical Club, asking that the Torrey Club join in a Decoration Day excursion to Tullytown.

One new member was elected on nomination of Dr. Rusby:

Dr. Jerome B. Thomas, Jr., Irving St., Brooklyn, N. Y.

The first paper, by Mr. Eugene P. Bicknell, on "Our Blue-eyed Grasses," described the character and habits of five local species of *Sisyrinchium* occurring within the hundred-mile limit. Three of these were distinguished by Mr. Bicknell three years ago in an article in the BULLETIN. More recently he has re-discovered the obscure *S. mucronatum* Michaux, which seems to be a rather local species. It imparted to the meadows a beautiful blue as seen during an excursion of the Torrey Club to Bushkill, Pa., in 1898.

Mr. Nash said that three of these species are growing at the New York Botanical Garden side by side in the same soil and conditions; and each continues clearly distinct.

The second paper, by Dr. N. L. Britton, was entitled "Notes on North American Cyperaceae," and was accompanied by the exhibition of sheets showing numerous critical species. The distribution of *Fimbristylis castanea*, which grows both in Atlantic salt marshes and in the interior, was remarked upon. A number of other salt marsh species occur both on the coast and in the interior; due perhaps to different former geographical conditions with presence of masses of salt water in the interior. Such are *Chenopodium leptophyllum* and *Glaux maritima*.

President Brown exhibited a recent collection of *Prabavema* in blossom.

Attention was called to the address by Professor Underwood, on the Kew Gardens, at the Museum of Natural History on April 13th.

Professor Britton announced the return of Mr. S. Henshaw from Porto Rico, bringing a very interesting collection of woods used by the people of that island, soon to be made the subject of an illustrated lecture before the Club.

On motion of Dr. Underwood, seconded by Dr. Britton, it was declared that the Club nominates E. S. Burgess as candidate for the Newberry grant for this year, for the furtherance of botanical research.

Adjournment followed.

WEDNESDAY EVENING, APRIL 26, 1899

Meeting held in the large hall of the College of Pharmacy.

President Brown in the chair; 60 present.

A letter was read from Mr. C. L. Pollard, Secretary of the Washington Botanical Club, offering entertainment to any of the Torrey Club who will join in the Decoration Day excursion from Georgetown, and who will notify him by May 20th.

Two new members were elected to the Club: Mr. Wm. S. Opdyke, 20 Nassau street, proposed by Dr. Rusby; and Mr. André Mali, 93 Willow street, Brooklyn, proposed by the Secretary.

The evening was devoted to an illustrated lecture by Mr. Cornelius Van Brunt, on "The Glaciers and Flowers of the Selkirks and Rockies," with numerous colored lantern slides. Mr. Van Brunt took up his narrative at Lake Louise, which he had just reached in the similar lecture given to the Club the previous winter. About 60 new views were shown, colored by Mrs. Van Brunt, exhibiting the glacier and rock surfaces with remarkable distinctness, and with beautiful mountain meadows of pink and yellow, clear lakes, and mossy bogs. Among the flowers which produce masses of color, yellow Arnica is most abundant and *Erigeron glabellus* next so. *Valeriana Sitchensis* and *Saxifraga Van-Bruntiae* are among the most beautiful. The mountain forget-me-not, *Linnaea borealis*, and *Cassiope tetragonum* occurred in great abundance.

Besides beautiful scenes about the Lake of the Clouds and Lake Agnes, the Kicking Horse River, and among glacier ascents and crevasses, Mr. Van Brunt exhibited views of the railway construction, snowsheds, hotels, guides and ponies, introduced a party from the Appalachian Mountain Club with their Swiss guide, and finished with a number of representative flowers of the eastern slope of the Rockies.

Adjournment followed.

TUESDAY EVENING, MAY 9, 1899

President Brown was in the chair.

32 persons were present.

A letter was read from an absent member, Dr. A. Emil Schmidt, now Chief of the Medical and Sanitary Department, Nile Reservoir Works, Assouan, Egypt. This letter, dated March 23, 1899, mentioning the present sterility of Assouan and the lack of any vegetation except the date-palm and sycamore, offered contributions in the future should anything of botanical interest develop during his expected seven years' residence. Dr. Schmidt also tendered his resignation as an active member, which was accepted, and, on motion of Dr. Britton, his name was transferred to the list of corresponding members.

Announcement was made of the Sixth Annual Flower Show at the Normal College, May 11th, 12th and 13th, being an exhibit of wild flowers of New York and vicinity, arranged by ladies of the Normal College Alumnae.

The Secretary made reference to his recent meeting with the New England Botanical Club and the expression of interest in the Torrey Club which was then made. He also alluded to the recent good fortune of the Harvard Herbarium in receiving those manuscripts of the botanist Manasseh Cutler, which had been in the hands of Oakes and of T. W. Harris, and until recently, of the

Tuckerman family. These include descriptions of many of the plants of eastern Massachusetts, written 1787–1804.

Dr. Britton made announcement of receiving at the N. Y. Botanical Garden a remarkable small-flowered form apparently of *Syndesmon thalictroides* with the flowers pink within and without, which is now planted.

The regular program of the evening consisted of an address by Mr. Samuel Henshaw, "Notes on the Flora of Porto Rico," giving an account of the people, customs, climate, and present conditions of that island. He exhibited numerous specimens of Porto Rican utensils and articles of household use of vegetable manufacture, including many applications of the calabash gourd, from spoons to chopping-bowls, many ways of using palm leaves, etc., etc. He referred to the immense growths of *Bougainvillea*, of Crotons in the open sun, of *Fourcroya*, *Lantana*, etc. He showed many photographs, portions of large tree-fern and bamboo trunks, a tall wooden mortar and dumbbell-shaped wooden pestle, musical instruments made from gourds and other sources. Orchids were few, the reports of their occurrence proving to be founded chiefly on Aroids and Tradescantias. By one coming from the North the most singular sensation is experienced on finding every common weed under foot to be what would have been a greenhouse plant at home.

After examination of specimens, the Club was adjourned.

WEDNESDAY EVENING, May 31, 1899

Twenty-four present. Dr. Underwood presided in absence of officers.

On the part of the committee on nature study, Miss Sanial described briefly the use of plant material in the vacation schools of New York City, and the need of donations of fresh flowers and other natural objects. Many of the children have never seen any wild flowers whatever. Any one who writes to the Board of Education, labelling the communication "For Vacation Schools," will receive the necessary blanks for forwarding.

Dr. Arthur Hollick's paper, "A Comparison between Geological Sequence and Biological Development in the Vegetable Kingdom," was to have been illustrated by lantern-slides, but was deferred. Dr. Hollick presented instead a short descriptive abstract of the subject, comparing the taxonomic series of vegetable life as it now exists and the phylogenetic series of the past, consecutive from Azoic to Neozoic time. He alluded to the first occurrence of modern genera in the Mesozoic, and of modern species in the Tertiary, and to the vigorous growth made by lower forms of algae in the hot waters of Yellowstone Park, suggesting that similar algal life was probably characteristic of the earlier heated waters of the globe. He stated that many of the Cambrian casts claimed to represent algae are undoubtedly rightly interpreted; and then sketched the successive appearances of the earliest known gymnosperms in the Devonian, monocotyledons in the Triassic, and dicotyledons in the Cretaceous, by the middle of which period many modern genera are recognized. Ferns and Lycopods of modern families appeared in the Devonian, the first known Musci, Hepaticae, and Fungi in the Tertiary. Plant remains in glacial deposits are exactly the same as species now living a little further to the north. The Carboniferous fern-species which have been figured and named outnumber those of the whole world now living. The coal flora was probably practically identical all over the world. Every time a new horizon is opened up, even down to the Tertiary, there are many new fossil ferns discovered in it.

The second subject presented was the exhibition and description of a hygroscopic plant-specimen by Dr. C. J. Eames. The specimen was originally described in an article entitled "The Resurrection Flower" in Harper's Monthly, April, 1857, p. 619. Dr. Eames' specimen seemed to be the ripened circle of ovaries of some malvaceous flower, and displayed very marked hygroscopic movement, expanding completely within fifteen minutes after moistening. Dr. Eames, a chemist, obtained his specimen in 1860 from Dr. I. Beck, who said that he had secured this, and one other like it, about 1849 when in Upper Egypt. The other specimen passed into the possession of Humboldt. Dr. Eames exhibited specimens of *Astraeus* and *Anastatica* for comparison, their hygroscopic movement being less perfect.

EDWARD S. BURGESS,
Secretary.

Index to Recent Literature relating to American Botany.

Arber, E. A. N. Relationships of the Indefinite Inflorescences. Jour. Bot. **37**: 160–167. Ap. 1899.

Bicknell, E. P. Studies in *Sisyrinchium*—I: Sixteen new Species from the Southern States. Bull. Torr. Bot. Club, **26**: 217–231. 15 My. 1899.

Author proposes new species under the following names: *Sisyrinchium corymbosum, S. solstitiale, S. tortum, S. Carolinianum, S. Floridanum, S. Nashii, S. rufipes, S. fuscatum, S. flagellum, S. Miamiense, S. scoparium, S. implicatum, S. rosulatum, S. furcatum, S. sagittiferum*, and *S. scabrellum.*

Biffen, R. H. On the Biology of *Agaricus velutipes* Curt. (*Collybia velutipes* P. Karst.). Jour. Linn. Soc. **34**: 147–162. *pl. 2–4.* 1 Ap. 1899.

Buchenau, F. E. Ule's brasilianische Juncaceen. Engler, Bot. Jahrb. **26**: 573–579. 18 Ap. 1899.

New species are described in *Luzula* and *Juncus.*

Davy, J. B. Concerning *Stapfia* Davy. Erythea, **7**: 43. 1 Ap. 1899.

Substitutes *Neostapfia* Davy for the preoccupied generic name *Stapfia* Davy, Erythea, **6**: 110. N. 1898.

Engler, A. Beiträge zur Kenntniss der Araceae IX.—16. Revision der Gattung *Philodendron* Schott. Engler, Bot. Jahrb. **26**: 509–564. 18 Ap. 1899. 17. Revision der Gattung *Dieffenbachia*, Engler, Bot. Jahrb. **26**: 564–572. 18 Ap. 1899.

Ganong, W. F. Advances in Methods of Teaching Botany. Science II. **9**: 96–100. 20 Ja. 1899.

Griffiths, D. The common Parasite of the Powdery Mildews. Bull. Torr. Bot. Club, **26**: 184–188. *pl. 358.* 12 Ap. 1899.

Discusses and figures *Ampelomyces quisqualis* Ces.

Hazen, T. E. The Life History of *Sphaerella lacustris* (*Haematococcus pluvialis*). Mem. Torr. Bot. Club, **6**: 211–244. *pl. 86, 87.* 8 Je. 1899.

Heckel, E. Sur quelques phénomènes morphologiques de la germination dans *Ximenia Americana* L. Bull. Soc. Bot. France, **45**: 438–441. Mr. 1899.

Kraemer, H. The Morphology of the genus *Viola.* Bull. Torr. Bot. Club, **26**: 172–183. 12 Ap. 1899. [Illust.]

Kränzlin, F. Orchidaceae Lehmannianae in Guatemala, etc. Engler, Bot. Jahrb. **26**: 449–502. 18 Ap. 1899.

New species are described in *Mardevallia, Bolbophyllum, Epidendrum, Liparis, Pinelia, Chrysocycnis, Sigmatostatrix, Maxillaria, Ornithidium, Camaridium, Rodriguezia, Diothonaca, Pterostemma, Odontoglossum, Oncidium, Goodyera, Gomphichis, Pelagia* and *Prescottia.* Two new genera, *Olopetalum* and *Neolehmannia* are established.

Lidforss, B. Weitere Beiträge zur Biologie des Pollens. Jahrb. wiss. Bot. **33**: 232–312. 1899.

Lister, A. Notes on Mycetozoa. Jour. Bot. **37**: 145–152. *pl. 398.* Ap. 1899.

Deals with various American specimens; *Physarum echinosporum* sp nov. from Antigua.

Loew, O. What is the cause of the so-called tobacco fermentation? Science II. **9**: 376–377. 10 Mr. 1899.

Malme, G. O. A. Bemerkungen über einige im Herbarium Müller Arg. auf bewahrte Species der Gattung *Pyxine* (Fr.) Nyl. Bull. Herb. Boiss. **7**: 226–228. 25 Mr. 1899.

Moore, S. Le M. Alabastra Diversa.—Part IV. Jour. Bot. **37**: 168–175. Ap. 1899.

Contains diagnosis of *Centaurea* (§ *Plectocephalus*) *Bridgesii* sp. nov. from Chili.

Nelson, A. New Plants from Wyoming.—V. Bull. Torr. Bot. Club, **26**: 5–11. 16 Ja. 1899; VI., **26**: 122–134. 18 Mr. 1899; VII., **26**: 236–250. 15 My. 1899.

New species and varieties in *Scirpus, Sagittaria, Lilium, Abronia, Arenaria, Aconitum, Astragalus, Ruppia, Salicornia, Arabis, Lesquerella, Lepidium, Streptanthus, Thelypodium, Lupinus, Viola, Pachylophus, Sphaerostigma, Peucedanum, Dodecatheon, Cuscuta, Gilia, Phacelia, Castilleia, Paronychia, Draba, Cerastium, Thermopsis, Anogra, Cymopterus, Pentstemon, Lappuia, Mertensia, Lithospermum* and *Erigeron*; *Wyomingia*, gen. nov., with two species.

Osterhout, G. E. New Plants from Colorado. Bull. Torr. Bot. Club, **26**: 256, 257. 15 My. 1899.

Potentilla rupincola sp. nov. and *Astragalus Hypoglottis bracteatus* var. nov.

Pax, E. Plantae Lehmannianae in Columbia et Ecuador collectae. Euphorbiaceae. Engler, Bot. Jahrb. **26**: 503–508. 18 Ap. 1899.

New species are described in *Phyllanthus, Croton, Acalypha* and *Euphorbai.*

Peck, C. H. Elliot C. Howe, 1828–1899. Bull. Torr. Bot. Club, **26**: 251–253. 15 My. 1899.

Pilger, R. Gramineae Lehmannianae et Stübelianae Austro-Americanae additis quibusdam ab aliis collectoribus ibi collectis determinatae et descriptae. Engler, Bot. Jahrb. 27: 17–36. 7 Ap. 1899.

Purpus, C. A. Eine Succulententour nach Baja California (Mexiko). Monatssch. für Kakteenkund, **9**: 33–38. 15 Mr. 1899.

Robinson, B. L. Revision of the Genus *Guardiola.* Bull. Torr. Bot. Club, **26**: 232–235. 15 My. 1899.

Author proposes as new *Guardiola Rosei*, *G. carinata* and *G. odontophylla*, and gives specific rank to *G. Tulocarpus arguta* Gray and *G. Tulocarpus angustifolia* Gray.

Perrot, M. E. Anatomie comparée des Gentianacées. Ann. Sc. Nat. Bot. VIII. **7**: 105–292. *pl. 1–9.* 1899.

Putnam, B. L. A white form of *Carduus arvensis.* Asa Gray Bull. **7**: 37. Ap. 1899.

Ricome, M. H. Recherches expérimentales sur la symétrie des Rameaux Floraux. Ann. Sc. Nat. Bot. VIII. **9**: 293–396. *pl. 10–13.* 1899.

Rowlee, W. W. Historic Trees of North America. 1. The Washington Elm. Plant World, **2**: 125, 126. 1899.

Rowlee, W. W. Description of two Willows from Central Mexico. Bot. Gaz. **27**: 136–138. *f. 1–2.* F. 1898.

Rydberg, P. A. The cespitose Willows of Arctic America and the Rocky Mountains. Bull. N. Y. Bot. Garden, **1**: 257–278. 13 Ap. 1899.

Salix palaeoneura, *S. petrophila*, *S. Macounii*, *S. Waghornei*, *S. niphoclada*, *S. Labradorica* and *S. Dodgeana*, sp. nov.

Salmon, E. S. Notes on the Genus *Nanomitrium* Lindb. Jour. Linn. Soc. **34**: 163–170. *pl. 5.* 1 Ap. 1899.

Sargent, C. S. New or little-known North American Trees. Bot. Gaz. **27**: 81–94. F. 1899.

Saunders, C. F. *Listera reniformis.* Plant World, **2**: 129. My. 1899.

Saunders, De A. New and little-known brown Algae of the Pacific Coast. Erythea, **7**: 37–40. *pl. 1.* 1 Ap. 1899.

Hapalospongidion gelatinosum gen. et sp. nov.; notes on *Leptonema fasciculatum* Reinke.

Schumann, K. Zwei neue Arten von Echinocactus aus Paraguay. Monatssch. für Kakteenkunde, **9**: 44–46. 15 Mr. 1899.

E. Grossei and *E. nigrispinus* sp. nov.

Selby, H. D. Additional host Plants of *Plasmopara Cubensis.* Bot. Gaz. **27**: 67, 68. J. 1899.

Setchell, W. A. Notes on Cyanophyceae, III. Erythea, **7**: 45–55. *pl. 2, 3.* 1 My. 1899.

Scytonema caldarium, *S. occidentale*, and *Nostoc amplissimum*, sp. nov.

Small, J. K. Undescribed Species from the Southern United States. Bull. N. Y. Bot. Garden, **1**: 278–290. 13 Ap. 1899.

New species in *Aletris*, *Allium*, *Dondia*, *Aquilegia*, *Hypericum*, *Callirrhoë*, *Passiflora*, *Leucothoë*, *Evolvulus*, *Dasystoma*, *Physostegia*, *Hedeoma*, *Teucrium*, *Plantago*, *Houstonia*, and *Iva*.

Solms-Laubach, H. Die Marchantiaceae Cleveideae und ihre Verbreitung. Bot. Zeit. **57**^{1}: 14–35. F. 1899.

Sturch, H. H. *Harveyella mirabilis.* Ann. Bot. **13**: 83–102. *pl. 3, 4.* Mr. 1899.

Stevens, F. L. A peculiar Case of Spore Distribution. Bot. Gaz. **27**: 138. *fig.* F. 1899.

Toumey, J. W. Sensitive Stamens in the Genus *Opuntia.* Asa Gray Bull. **7**: 35–37. Ap. 1899.

Underwood, L. M. American Ferns—II: The Genus *Phanerophlebia.* Bull. Torr. Bot. Club, **26**: 205–216. *pl. 359, 360.* 15 My. 1899.

Phanerophlebia umbonata, *P. auriculata*, *P. macrosora* and *P. Guatemalensis* sp. nov.

Underwood, L. M. A new *Cantharellus* from Maine. Bull. Torr. Bot. Club, **26**: 254, 255. 15 My. 1899. [Illust.]

Warming, E. On the Vegetation of Tropical America. Bot. Gaz. **27**: 1–18. J. 1899.

Wiegand, K. M. A Revision of the Genus *Listera.* Bull. Torr. Bot. Club, **26**: 157–171. *pl. 356, 357.* 12 Ap. 1899.

Listera auriculata sp. nov. and *L. Smallii* (*L. reniformis* Small) nom. nov.

Woods, A. F. Brunissure of the vine and other plants. Science II. **9**: 508–510. 7 Ap. 1899.

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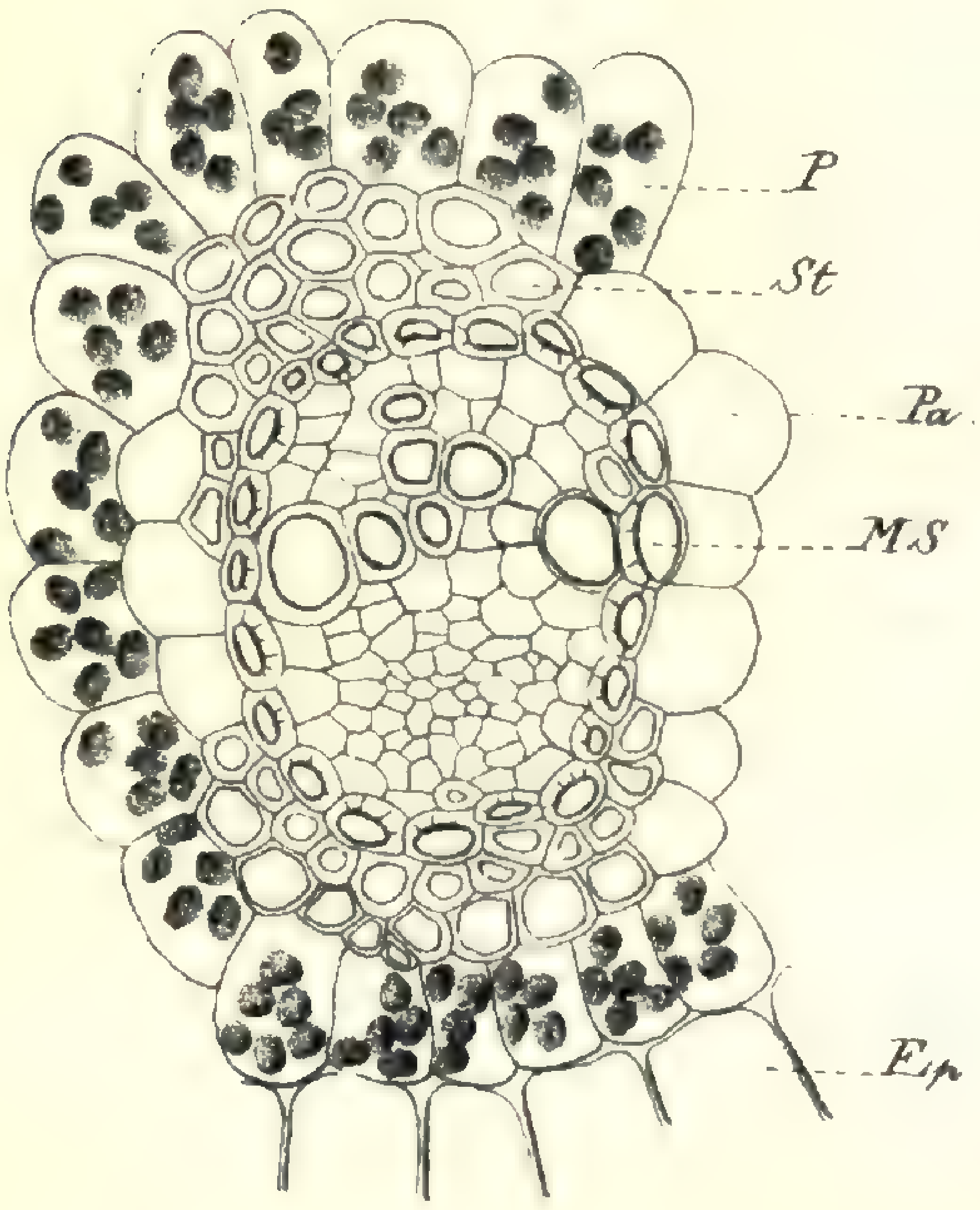

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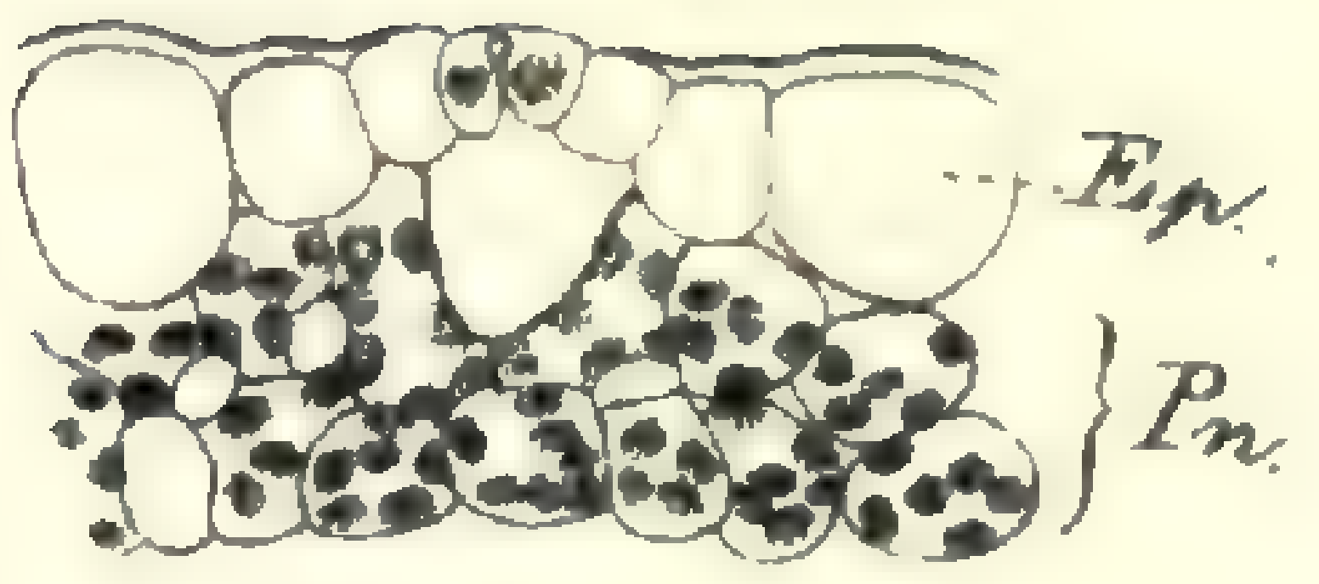

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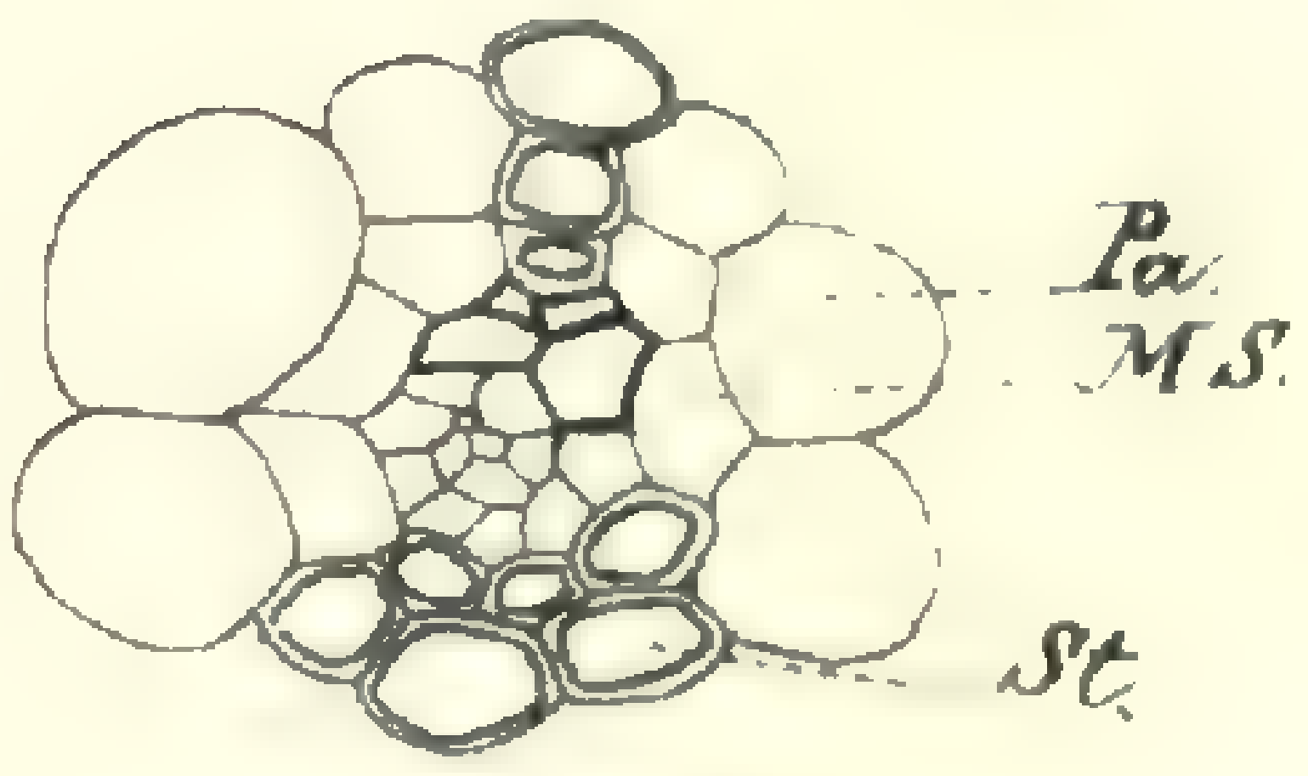

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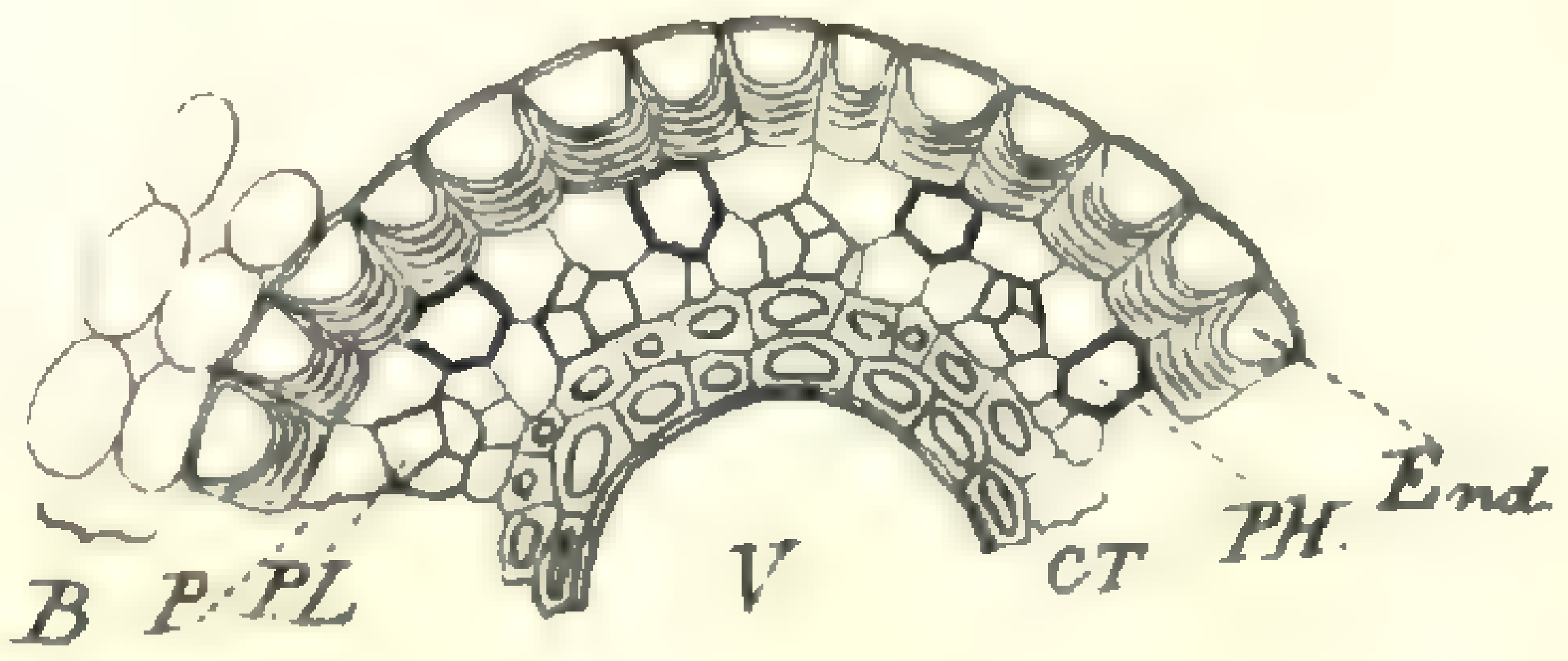
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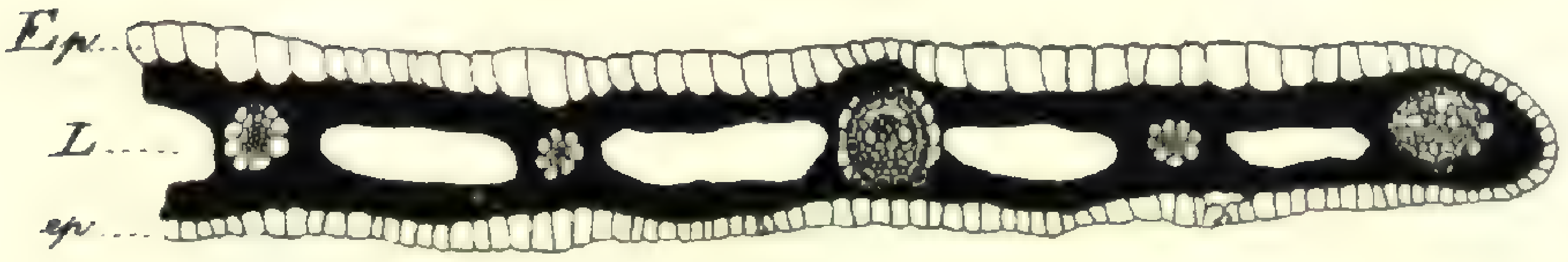

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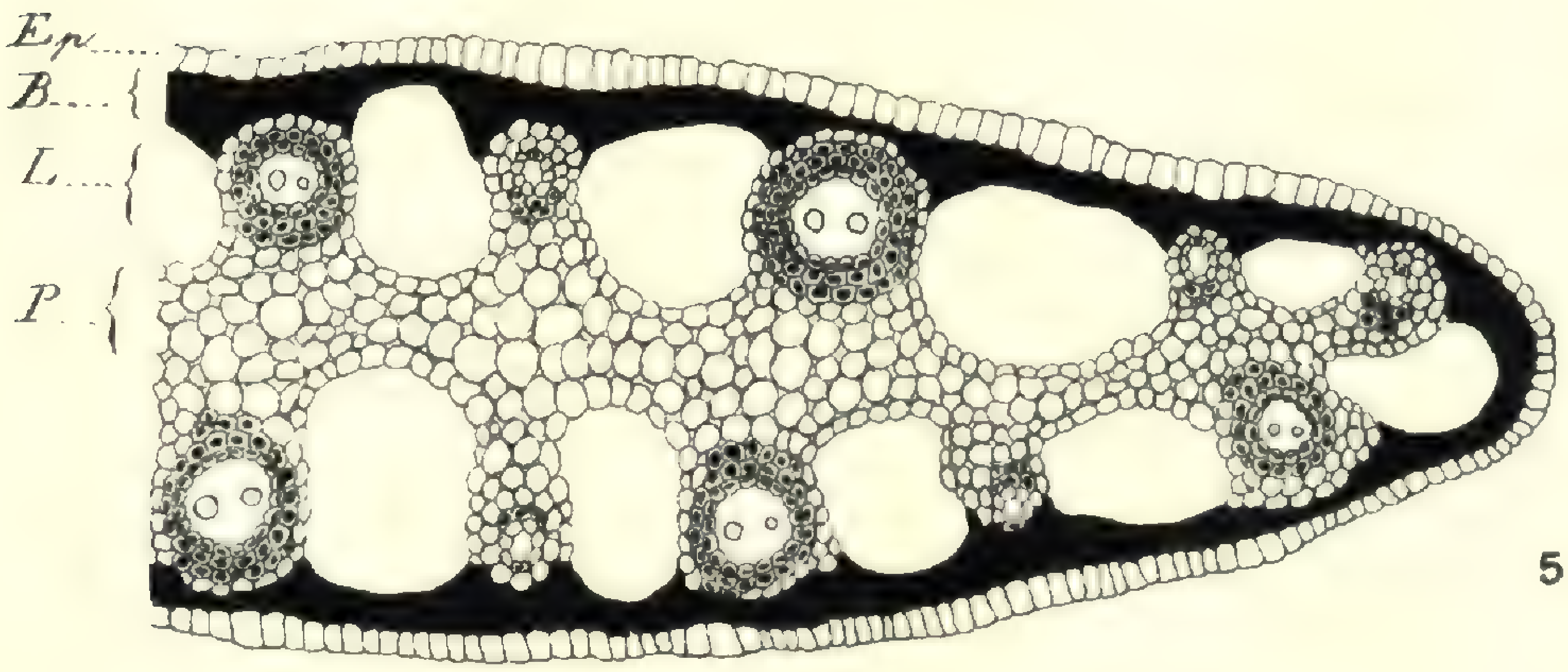

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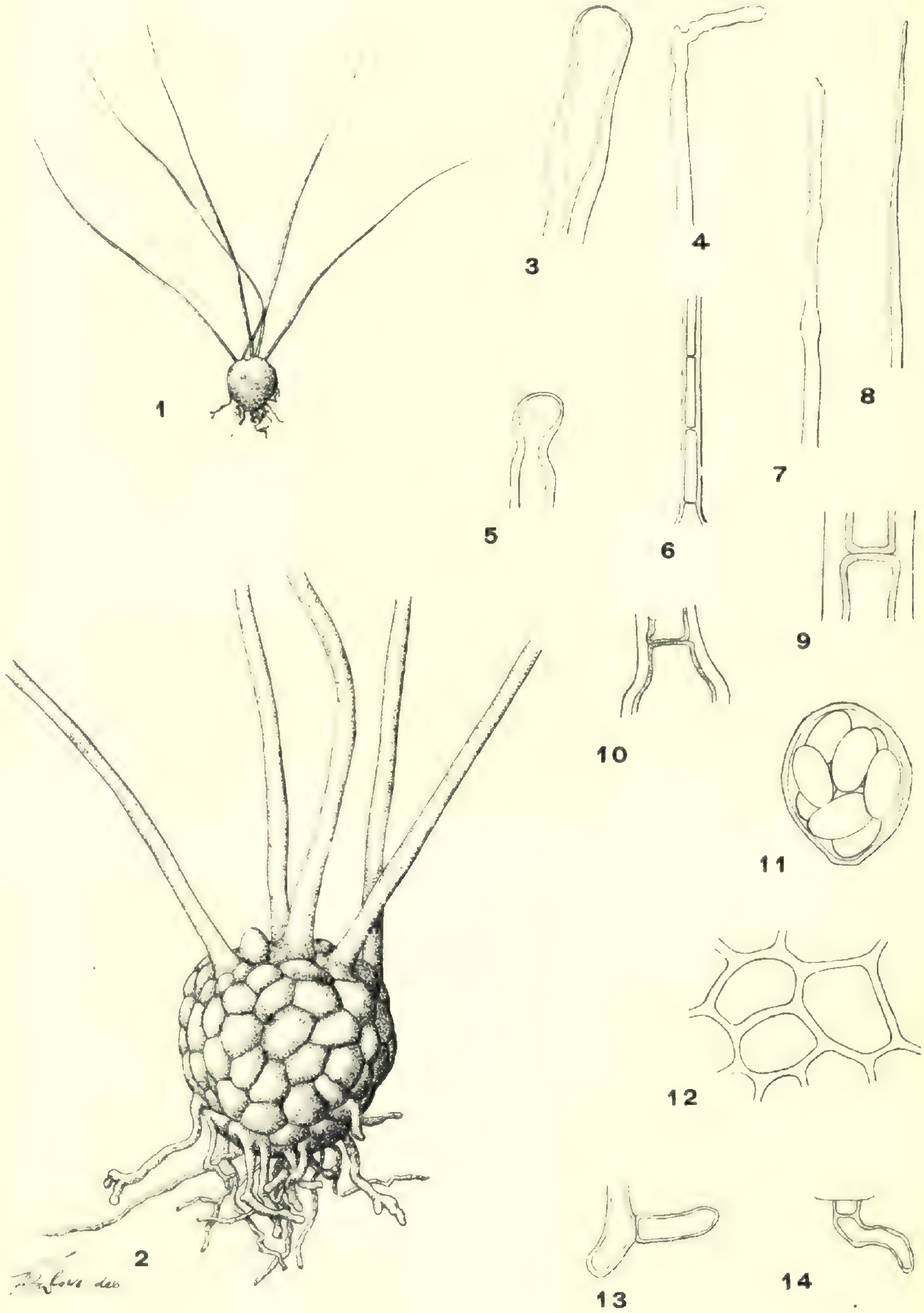
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AUGUST 1899

Some Species of Bidens found in the United States and Canada

BY K. M. WIEGAND

Several years ago, while collecting in the vicinity of Ithaca, N. Y., the writer found a number of specimens of *Bidens connata*, on which the awns were upwardly barbed. Until recently * such specimens have been considered to be hybrids with some species of *Coreopsis*, but in the plants in question there were no characters to warrant such an assumption further than the mere fact of the difference in direction of the barbs. It was thought best, therefore, to attempt a study of this group to determine, if possible, the exact affinities of the various forms and the constancy of some of the more important characters. *B. cernua* and *B. laevis*, in Central New York, have also been much confused, mainly, however, because of the presence of the form here distinguished as *B. cernua intermedia.* It was decided on this account to include these two species also in the proposed study.

Since that time a large mass of material has been collected and many field notes have been made from plants growing in various portions of New York State. To supplement this, specimens have been examined from many other localities throughout the United States and portions of Europe and Asia. In September, 1897, the writer was able to separate the *B. connata comosa* Gray as a distinct species, and now the study has reached such a stage as to warrant the publication of all the results.

---

* Britton, Bull. Torr. Bot. Club, **20**: 280. 1893.

[Issued 17 August.]

The value of the different characters from a taxonomic standpoint has, in general, been found to agree with that placed upon them by previous authors. The most important of all is, of course, the achene, and by this one character alone most of the species may be recognized. Very much dependence cannot be placed upon the leaves, because of the unusually great variation produced by environment, through which influence both the size and the incisions are modified. Two other structures, the involucre and the corolla, have, however, been used much more than by previous writers.

The involucre varies principally in the size and number of bracts, and is important for specific distinction rather than to show lines or strains of variation. In this respect it differs from the corolla, in which the pale yellow, 4-toothed character is found practically constant among a number of related species, while the orange, 5-toothed type represents another group, both evidently distinct lines of development. But the corolla does not show all the lines of variation or even the primary ones. To determine these one must look to the achene. The number of awns is found to be much more constant than was before supposed. Only one species, *B. laevis,* really shows a variation in number without a corresponding change in other characters. Some allowance must, of course, be made for the fact that the outer achenes usually show a shortening of the awns which process is often carried so far that some are entirely obliterated.

In determining specific differences the direction of the barbs upon the margins of the achene seems to be of more importance than upon the awns. So far as known, no specimens of species having truly downwardly barbed achenes have been found with upwardly barbed awns ; moreover, it seems possible that when erect barbs are found in *B. melanocarpa* and *B. connata* they are to be considered as a continuation of the hairs of the achene out upon the awns, thus excluding the real barbs, and not as a reversal of the barbs themselves. Whether this is really the case has not as yet been definitely settled. In some cases the erect barbs are nearly as slender as the hairs on the achene, but more often they are stouter. The hairs and warts upon the achenes, although more or less characteristic in some species, are not of special diagnostic value.

There has in the past been considerable discussion regarding the occurrence of hybrids among species of *Bidens* and *Coreopsis.* Every specimen, however, which the writer has seen labeled as such differs from one or the other of the supposed parents only in the direction of the barbs upon the awns. Although hybrids might be expected among these annual plants their occurrence is very doubtful.

If the direction of the barbs is not constant among the individuals of one species this character can obviously not be used for the separation of the genera *Coreopsis* and *Bidens*, a fact which has already been strongly emphasized by Dr. Britton. Indeed, a number of species of *Coreopsis* are evidently *Bidens* except for their barbs. The transferrence of these species to the genus *Bidens* becomes therefore necessary for a correct interpretation of the two genera.

The section PLATYCARPAE, the principal members of which are here treated, should therefore consist of the following species in northern North America: *B. frondosa*, *B. melanocarpa*, *B. discoidea*, *B. connata*, *B. comosa*, *B. bidentoides*, *B. dentata*, *B. cernua*, *B. laevis*, *B. Nashii*, *B. coronata*, *B. trichosperma*, *B. aristosa*, and *B. involucrata.*

The writer wishes to thank Dr. Robinson for kindly loaning the material in the Gray Herbarium, and Dr. Small for loaning that in the Herbarium of Columbia University; also the New England Botanical Club for the opportunity of studying a large amount of material from the vicinity of Boston; and especially Mr. E. P. Bicknell, a critical student of this group, who has generously furnished valuable suggestions and extensive notes upon many of the species.

Synopsis of the Species

A. Achenes upwardly barbed on the margins; corolla 4–5-toothed; awns 2; rays small or none.

Outer involucral bracts 4–8, inner oblong, equaling the disk or longer; ovaries of the ray-flowers hairy, minutely awned; achenes narrow, nearly black, hairy, papillose or tuberculate, rarely smooth, margins upwardly barbed to base of awns.

Corolla stramineous, 4-toothed; achenes long and very narrow, awns filiform, upwardly barbed; leaves simple; outer involucral bracts 4–5, inner longer than the achenes. 1. *B. bidentoides.*

Corolla orange, 5-toothed; achenes of ordinary form; leaves pinnate; inner involucre equaling the achene.

Leaves 3-foliolate, leaflets long-acuminate; heads very small (9 mm. broad), on very short peduncles; achenes very small (4.5 mm.), thickish, awns scarcely longer than the breadth of the achene, upwardly barbed; outer involucral bracts 4. 2. *B. discoidea.*

Leaves larger, 3–5-pinnate, leaflets acute to acuminate; heads larger; achenes 6 mm. long; awns half as long as the achenes or more, commonly downwardly barbed; outer involucral bracts 6–8. 3. *B. melanocarpa.*

Outer involucral bracts 10–16; inner ovate-triangular, short; corolla stramineous; heads long-peduncled; ovaries of the ray-flowers glabrous, awnless; achenes broad and flat (½ as broad as long) brown, nearly glabrous and smooth (rarely papillose); margins on the upper one-fourth downwardly barbed. 4. *B. frondosa.*

B. Achenes downwardly barbed, flat or flattish, brown, glabrous or nearly so, not tuberculate, slightly contracted at the top, awns 2–4; corolla usually stramineous, funnelform; outer involucral bracts 6–8; leaves except in no. 6 more or less petioled.

Rays wanting (or at least not exceeding the disk); corolla 4-toothed.

Achenes of small or medium size (8 mm. or less); awns 2 (except in one var.), ⅔ the length of the achene or less; leaves incised or parted. [*B. tripartita.*]

Achenes large (8–11 mm.; in var. 5–7 mm.); awns 3, over one half the length of the achene; leaves serrate. 5. *B. comosa.*

Ray flowers present, ligule one half longer than the disk; corolla 5-toothed; awns 4 (rarely 2); leaves deeply serrate or incised. 6. *B. dentata.*

C. Achenes usually both upwardly and downwardly barbed on the same margin, 4-angled, tuberculate; awns 4 (rarely 3); corolla orange, 5-toothed, abruptly contracted; leaves simple (sometimes deeply lobed); outer involucral bracts 4–7; heads commonly rayless. 7. *B. connata.*

D. Achenes downwardly barbed, biconvex or 4-angled, nearly glabrous, tuberculate on the angles, often striate, dark-green or blackish; awns 2–4; corolla deep yellow, 5-toothed, abruptly contracted; outer involucral bracts 8; heads large, often cernuous in fruit; rays commonly long and showy; leaves sessile.

Outer involucral bracts exceeding the disk, unequal, spreading, foliaceous; rays twice the length of the disk or less; leaves long (8–16 cm.), more or less clasping and connate, teeth distant; achenes 4-angled, slightly dilated at the summit. 8. *B. cernua.*

Outer involucral bracts rarely exceeding the disk, nearly equal and seldom conspicuously foliaceous, slightly fleshy; rays 2–4 times the length of the disk; achenes not dilated above, flat, 1-nerved on the outer face; plant sparingly branched above or simple, helianthoid in appearance; leaves shorter, rarely connate (5–12 cm.), teeth closer.

Leaves lanceolate, acute or short-acuminate, sharply serrate, not fleshy, usually tapering at the base; branches spreading; margin of the achene straight from awns to base. 9. *B. laevis.*

Leaves elliptic or oblanceolate-oblong, acute, minutely serrate or almost entire somewhat fleshy, some of the upper often very broad at the base, but rarely clasping; branches strict, erect; achenes slightly contracted at the summit. 10. *B. Nashii.*

1. BIDENS BIDENTOIDES (Nutt.) Britton, Bull. Torr. Bot. Club, **20**: 281. 1893

Diodonta bidentoides Nutt. Trans. Am. Phil. Soc. II. **7**: 361. 1841.

Coreopsis bidentoides T. & G. Fl. N. A. **2**: 339. 1842.

Erect and stout (20–80 cm.), stramineous, glabrous: branches short and spreading: leaves pale, undivided, lanceolate to linear-lanceolate (blade 6–10 cm.), on more or less margined petioles (2–5 cm.), regularly tapering to the acuminate apex, coarsely and distantly serrate-dentate, attenuate at the base, upper leaves shorter and on more margined petioles: heads on rather slender peduncles which are mostly shorter than the leaves, longer than broad (15–18 × 10–12 mm.), stramineous; outer involucral bracts 4–5, linear or linear-spatulate, 1–3 times the length of the disk, not ciliate, entire, erect; inner bracts 5, oblong-linear, barely acute (15 mm.) and with the chaff much longer than the flowers: ray flowers rarely present, ligule strap-shaped, not exceeding the head; the ovaries similar to those of the disk: corolla of the disk flowers pale-yellow, large (5 mm. long, ½ length of awns), funnelform, 4-toothed, basal portion equaling the upper: stamens rarely exserted: mature achenes very slender, linear-cuneate, convex (8–10 mm.), dark-brown, not papillose, hairy, margins upwardly hairy: awns 2 (rarely a third very short one) very slender and nearly as long as the achene, upwardly barbed.

Muddy shores of the Delaware River and Bay, Pennsylvania to Maryland.

Specimens examined from:—Pennsylvania: Philadelphia, *Durand.* New Jersey: Camden, *Parker, Diffenbach;* Salem, *Commons.* Delaware: New Castle, *Canby;* Wilmington, *Canby, Commons* (with rays). Maryland: Bush River, *Canby.*

Of all the species of *Bidens* within our limits this is the most limited in distribution. It is, so far as known, confined entirely to the shores of the Delaware River and Bay, where it may be found growing in the mud at tide-water. The species is very constant in its characters as well as very unique, and must be considered as representing a line of development by itself. With *B. discoidea* it agrees only in having upwardly barbed awns and hairy achenes, but is remarkably distinct in the form of the achene and in the corolla. The foliage on the contrary resembles quite closely *B. comosa.* Its affinity seems not to be with any of the species discussed in this paper. The flowering period is from Sept. 1 to Oct. 15.

2. BIDENS DISCOIDEA (T. & G.) Britton, Bull. Torr. Bot. Club, **20**: 281. 1893.

Coreopsis discoidea T. & G. Fl. N. A. **2**: 339. 1842.

Stem tall and much branched, slender, reddish: leaves 3-foliolate, small, glabrous, petioles very slender (3 cm.), marginless; leaflets lanceolate to ovate-lanceolate, short (4–9 cm.), long-acuminate, sharply and coarsely serrate below the entire point, abruptly contracted at the base, the terminal on a long slender stalk (5–15 mm.), lateral slightly smaller on shorter stalks, uppermost leaves sometimes undivided, dark-green: heads very small and numerous (8–10 mm. broad), on very short peduncles (1–4 cm.), globular; outer involucral bracts linear to spatulate-linear, rarely longer than the disk, commonly 4, not ciliate, glabrous; inner bracts oblong or elliptic-oblong, obtuse (6–7 mm.), brownish, equaling the disk; chaff commonly reddish tipped: ray flowers none: corolla of the disk flowers very small (1.75–2 mm.), orange, equaling or slightly longer than the awns, campanulate-oblong above, 5-toothed, contracted into a basal portion shorter than the upper: stamens slightly exserted: mature achenes very small (4–5.5 mm.), rather narrow, cuneate, contracted at the summit, biconvex, black, hairy, tuberculate-papillose or nearly smooth, margins upwardly hairy, summit truncate, awns 2, very short (scarcely longer than the breadth of the achene), upwardly hairy.

Massachusetts to North Carolina (*Chapman*) and westward to Ohio, Louisiana and Texas.

Specimens examined from:—Massachusetts: Stony Brook Res., *Rich.* Connecticut, *Wright*, 1879. New York: Ithaca (many specimens); Oswego Co., *Wibbe, Rowlee.* New Jersey, Morris Co., *Porter.* Pennsylvania: Luzerne Co., *Heller*, no. 60. Delaware, *Canby.* Maryland, *Canby.* Ohio, *Sullivant*, 1839. Missouri, *Engelmann.* Arkansas, *Letterman.* Louisiana, *Hale*, 1842. Texas, *Lindheimer*, *Drummond.*

This species is on the whole less common in the eastern portion of its range than are most of the others, and judging from the specimens cited above it must be quite rare in New England. In New York and Pennsylvania it is found only near sphagnous bogs and mountain lakes, selecting preferably old logs and stumps that project out into the water. So far as observed it is quite constant in its characters, and although some cases of retrorse awns have been reported* none have been observed by the writer. Its only close relative is *B. melanocarpa* from which it is often very difficult to distinguish some of the smaller forms. The smaller, more acuminate leaves, and smaller achenes with upwardly barbed awns are the only reliable distinguishing characters. Some of the western specimens are often quite robust. The flowering period is September and October.

3. **Bidens melanocarpa** sp. nov.

B. frondosa Torr. Fl. N. Y.; Darl. Fl. Cest. Not L.

Stem 50–70 cm. high or more, slender, bushy-branched, the branches mostly spreading: leaves pinnately 3–5-foliolate, glabrous or nearly so except the scabrous margins, petioles very slender, scarcely margined (3–4 cm. long); terminal leaflet (4–8 cm. long) lanceolate to oblong-lanceolate, acuminate, tapering into a long stalk (10–15 mm.), occasionally 3-lobed at base, sharply and saliently serrate with either medium or coarse teeth; lateral leaflets about ⅓ shorter, less acuminate, more truncate and often very oblique at the base: heads on slender ascending peduncles of medium length, rather small (largest about 15 mm. diameter), hemispherical or globular; outer involucral bracts 6–8, spatulate-linear, mucronate, entire, sparsely ciliate, equaling the disk or sometimes twice as long (10–15 mm.); inner bracts brownish, 8–12, oblong, scarcely acute (8 mm. long), apex slightly pubescent; chaff often reddish-tipped: ray flowers usually present, ligule broadly oval, equaling the disk, golden yellow, caducous, the ovaries narrowly and evenly cuneate, hairy, hairs on the margins in clusters and directed upward, summit convex, awns 2, divergent, scarcely longer than the breadth of the ovary, downwardly barbed: corolla of the disk flowers small (2.5–3 mm.), shorter than the awns, 5-toothed, orange, campanulate-oblong, slightly contracted below, basal portion shorter than the upper: stamens exserted: achenes in fruit (6 × 3.25 mm.) cuneate, slightly contracted at the summit, flattish, costate, nearly black, tuberculate, sparsely hairy, margins upwardly hairy to base of awns, summit truncate: awns short (⅓–½ length of achene), slender, slightly divergent, strongly downwardly barbed (rarely barbs erect).

New Brunswick to Florida, westward to Texas and Nebraska.

Specimens examined from:—New Brunswick: *Chalmers* (*ex* Macoun). Maine: *Parlin*; *M. E. Hill*, no. 93. New Hampshire:

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* Britton, Bull. Torr. Bot. Club, **20**: 280. 1893.

W. Deane; Robinson, no. 361. Massachusetts: *Boott; Collins; Rich; French; Young.* Rhode Island: *Thurber.* New York: *A. M. Vail; Kearney; Britton; Rowlee, et al.* New Jersey: *Torrey; Commons; Halsted*, no. 36. Pennsylvania: *Smith* (upwardy barbed awns). West Virginia: *Millspaugh*, no. 778. Florida: *Chapman.* Alabama: *Buckley.* Louisiana: *Hale.* Texas: *Lindheimer; Reverchon.* Missouri: *Bush*, no. 167; *S. Weller.* Illinois: *Wolf; DeForest.* Nebraska: *Rydberg*, no. 1707; *Clements*, no. 2894.

Bidens melanocarpa pallida var. nov.

Slightly glaucous, branches all ascending or erect, conspicuously overtopping the terminal shoot: leaves smaller, on shorter more margined petioles (3–4 cm. long), dull, veins inconspicuous, the lower ternate, the upper undivided; leaflets shorter, ovate-lanceolate, short-acuminate, the terminal contracted at the base into a winged stalk and more or less confluent with the lateral, coarsely and sharply few-toothed: heads longer than in the type, on longer peduncles; outer involucre erect, foliaceous (2–4 times length of head), rarely ciliate; inner bracts oblong lanceolate: corolla of disk flowers larger (3–4 mm.), often 4-toothed, more nearly yellow, shorter than the awns: achenes (5–10 mm.), not papillose: awns longer (about ½ length of achene).

Nova Scotia to New York and Illinois.

Specimens examined from:—Nova Scotia: Halifax, *Brother Peter*, 1896. Illinois: *Wolf.* New York: Ithaca (many specimens).

This species is quite widely distributed throughout the eastern portion of North America, and is everywhere very abundant. In the New England states it seems to be the most common type of the *frondosa* group, but in New York State and farther westward *B. frondosa*, with which it has so long been confused, is equally abundant. It usually prefers rich damp soil and forms a large part of the vegetation along roadsides, in waste places, and on the margins of rivers and ponds during the autumn months. In structural characters it is more distinct than are *B. cernua* and *B. laevis*, but has nevertheless never been separated from *B. frondosa*. It is however much more closely related to *B. discoidea*.

B. melanocarpa is exceedingly variable. When growing in exposed localities it often has much narrower leaflets and is 5-pinnate, but when in shaded places the leaves are usually only 3-pinnate and leaflets very broad. In the vicinity of sphagnous bogs it often becomes more bushy, with smaller leaves and more acuminate leaflets, in which condition it resembles *B. discoidea* very closely. The specimens with upwardly barbed awns collected by various botanists and thought to be hybrids between this species and *B. discoidea* or *B. bidentoides* can scarcely be considered as such since they do not show the necessary intermediate condition of other characters. In fact, with the exception of the barbs, all the characters are identical with those of this species. It seems better for the present to consider them as accidental forms of *B. melanocarpa.*

B. melanocarpa cannot be distinguished from the other species of North America by any one character. From *B. frondosa* it differs by its fewer involucral bracts, narrower upwardly barbed achenes and orange flowers; from *B. connata* by its 2-awned achenes and pinnate leaves; from *B. discoidea* by the larger, less acuminate leaflets, and larger more tuberculate and longer-awned achenes and more numerous involucral bracts. It is very closely related to *B. tripartita* of the Old World, some of the broader leaved forms of which differ only in having blunter teeth and downwardly barbed achenes with yellow corollas. It seems to form a transition between *B. tripartita* and *B. connata* on the one hand and between *B. discoidea* and *B. connata* on the other.

The var. *pallida* although widely distributed, judging from the specimens representing it in the larger herbaria, seems not to be very common. In the vicinity of Ithaca, N. Y., however, it is abundant along the shores of Cayuga Lake, where its habit makes it quite conspicuous. In many respects the reduction of the leaves and lengthening of the peduncles suggests a condition similar to that which in *B. connata* and *B. comosa* was determined to be a "second growth," but here the plants seem to be perfectly normal and healthy. Moreover they differ in some important structural characters regarding the head and achenes, and in the long branches overtopping the terminal head. Considering the character of the heads and achenes alone, it might almost be taken for a hybrid with *B. comosa*, but the leaves and general habit are not at all intermediate. It seems best at present to consider these forms as forming a distinct variety. The flowering period of *B. melanocarpa* is from Aug. 15th to Sept. 25th.

4. BIDENS FRONDOSA L. Sp. Pl. 832. 1753.

Also of Willd. (in part); Torr. Fl. N. U. S. (in part); Bigelow Fl. Bost.; T. & G. Fl. N. A.

Stem tall and branching, glabrous, furrowed, reddish, branches spreading: leaves pinnately 3–5-foliolate (commonly 5-) on slender marginless petioles (2–4 cm. long), scarcely paler beneath, glabrous or nearly so, the straight veins prominent; leaflets lanceolate, tapering evenly to the very acute apex, serrate, with numerous sharp or bluntish regular teeth, all abruptly contracted at the base and short-stalked, the lateral oblique; rachis narrowly margined: heads large (15–25 mm. broad), broader than high, on long stout peduncles (3–16 cm.); outer involucral bracts linear or narrowly spatulate, unequal, numerous (10–16), scarcely exceeding the disk (rarely twice as long), conspicuously ciliate, entire; inner bracts brownish-olive, 14–18, mostly ovate or narrowly triangular, often abruptly contracted at the pubescent apex, mostly shorter than the disk: ray flowers usually present, ligule elliptic-oval, equaling the disk, pale yellow or often whitish, caducous, the ovaries (5–6 mm. × 1½–2 mm.), cuneate, broader and shorter than in *B. melanocarpa*, slightly contracted at the summit, truncate, awnless, entirely glabrous except occasionally a few upward barbs on the margins near the summit: corolla of the disk flowers of medium size (2.5–4 mm.), funnelform, pale yellow, 4–5-toothed, not conspicuously contracted below, two thirds length of awns, basal portion shorter than the upper: stamens usually included: achenes in fruit large, very flat and broad (7.5–9 mm. × 4.5–5 mm.), cuneate, slightly contracted at the summit, brown or olivaceous, smooth or merely papillose, nearly glabrous, 1-nerved on each face, margins downwardly barbed on the upper fourth, hairs erect below, summit truncate, awns 2, erect or divaricate, ½ length of the achene or more, strongly downwardly barbed.

Ontario to North Carolina, Missouri and westward to California and British Columbia.

Specimens examined from:—Ontario: Hull, *Macoun*, 1889. New York: *Barrett*, *Britton*, *DuBois*, *Townsend*, *Wiegand*, *et al.* Pennsylvania: *Moser.* Kentucky: *Short.* Virginia: *Curtiss.* Illinois: *DeForest.* Wyoming: *Nelson*, no. 2749. Upper Platte, Torr. Herb. California: *Bidwell*, no. 328. Washington: Columbia River, *Suksdorf*, nos. 412 and 1591.

Bidens frondosa puberula var. nov.

Branches, leaves and involucre more or less finely crisp-pubescent, with whitish hairs, the last often densely so; inner bracts pubescent on the back; leaves somewhat more finely and bluntly serrate.

Wisconsin and Missouri to the Saskatchewan.

Wisconsin: Green Bay, *J. H. Shutte*; Devils Lake, *Morgan*. Nebraska: *Webber*, 1886; *Clements*, no. 2894, 1893. Missouri: Courtney, *Bush*, no. 29, 1892. Saskatchewan, *Bourgeau*, 1857.

Bidens frondosa is common throughout the Middle and Western States, but does not seem to appear in New England. In late autumn it forms a very conspicuous part of the vegetation along roadsides and in waste places, especially where the soil is rich and damp, and may be found in flower from Aug. 15 to Sept. 15 or rarely until Oct. 1.

The plants produce ray flowers in considerable abundance in the earlier heads. They are, however, very caducous, and mostly absent altogether in the later heads; as a result of which a patch bearing rays early in the season may appear entirely rayless at a later period. Very few plants, if any, are entirely destitute of rays.

Considerable difficulty has been experienced in deciding whether Linnaeus' plant was of this species or the preceding. The original description which is rather longer than usual characterizes the leaves as pinnate and linear, seeds one half narrower than long, peduncles longer than the leaves; all of which indicate this species rather than *B. melanocarpa*.

Bidens frondosa is perhaps the most distinct of all the species in structural characters, although not in general appearance. Its two nearest relatives are *B. melanocarpa* and *B. tripartita*, from the former of which it may be distinguished by the longer peduncles, larger number of involucral bracts, the deltoid inner ones, the pale yellow corolla, form of the sterile ovaries of the ray flowers, and the broad, smooth, brown achenes, and from the latter by the pinnate leaves, long peduncles, outer and inner involucre, 5-toothed corolla and broad achenes.

Bidens tripartita L. of the Old World properly belongs here. It is closely related to *B. melanocarpa* and somewhat intermediate between that species and *B. frondosa*. Through it also *B. melanocarpa* is connected with *B. connata*, *B. comosa* and *B. cernua*. The typical form has 3-parted leaves and coarsely serrate divisions with the teeth usually rather blunt; but the variations are very great and without doubt several species are now aggregated under one name. A simple-leaved pale form from central Europe with often only 3 awns and large foliaceous involucre is difficult to distinguish from some forms of *B. comosa*, and is probably the *B. tripartita integra* of Koch. Another simple-leaved form with small heads and corky-thickened 2-awned achenes from southern Europe and Asia is *B. tripartita tenuis* DC. A third form with comose often cernuous heads, incised sessile leaves and two awns connects this species with *B. cernua* and has been separated as *B. platycephala* Oersted.

B. tripartita is found throughout Europe, Asia and Japan, but so far has not been found in North America (Addison Brown reported it as a ballast plant at Hunter's Point in the vicinity of New York City, Bull. Torr. Bot. Club, **16**: 357. 1879).

5. BIDENS COMOSA (A. Gray) Wiegand, Bull. Torr. Bot. Club, **24**: 436. 1897.

B. connata DC. Prod.; T. & G. Fl. N. A.; Torr. Fl. N. U. S. (in part); Darl. Fl. Cest.

B. connata comosa A. Gray Man. 261. 1867 [ed. 5].

Pale throughout: stem stout, erect (30–80 cm.), glabrous, stramineous or sometimes reddish, internodes rather short; branches short, spreading: leaves undivided (8 cm. long), pale green, narrowly elliptic or elliptic-lanceolate, acute, attenuate at the base into a short strongly margined petiole, serrate with rather small regular teeth (rarely coarser ones, and the upper nearly entire): heads not numerous, large (12 mm. high × 12–18 mm. broad) nearly globular or broader, on short stout peduncles thus often appearing clustered, erect; outer involucral bracts 6–8, linear or linear-lanceolate, mucronate, usually entire, very large, conspicuous and unequal, 2–5 times the length of the disk (30–50 mm. long), nearly erect; inner bracts oblong-ovate to ovate-lanceolate, acutish, stramineous, about 8 in number: ray flowers wanting: corolla of the disk flowers large (5 mm.), narrow funnelform, pale yellow, 4-toothed, gradually contracted into a basal portion which is longer than the upper, equaling the awns: stamens and style included: mature achenes large and flat (8–10 mm. × 3 mm.) scarcely carinate, cuneate with a broad base, slightly contracted at the summit, dark olive-green or brownish, not papillose and glabrous or nearly so, often dark-punctate, margins strongly retrorsely barbed, summit convex; awns 3, long and conspicuous (two long ones ⅔–¾ length of achene, third shorter, rarely a fourth very minute), erect, retrorsely barbed.

Maine to West Virginia, westward to Minnesota and Colorado and from Western Georgia (Chapman), Louisiana.

Specimens examined from :—Maine : Orono, *Fernald.* Massachusetts : Revere, *H. A. Young.* New York : *Torrey, Britton, Hulst* (many from central N. Y.). New Jersey : *Parker, Nash.* West Virginia : near Bucklin, *Pollock.* Tennessee : *Ruth,* no. 32. Kentucky : *Short.* Ohio : *Werner, Lea,* no. 167 (Torr. Herb.). Illinois : *Chapman, DeForest.* Minnesota : *Holzinger.* Kansas : *Norton,* no. 281, Riley Co. Missouri : *Bush,* no. 167 (in part). Louisiana : *Hale.* Colorado : Lincoln Co., *Rydberg,* no. 190.

Bidens comosa acuta var. nov.

Habit as in the type, but leaves sessile or nearly so : heads much broader (broader than high, 10–20 mm. broad) and achenes more spreading ; outer involucral bracts only twice the length of the disk or less, conspicuously spreading, lanceolate, acute and apiculate ; inner narrowly triangular-lanceolate, acute.

Kansas and Missouri.

Specimens examined :—Kansas : Manhattan, *Norton,* 1892. Missouri : *Engelmann,* St. Louis, 1866. Missouri : *Bush,* no. 164, Jackson Co. ; nos. 31 and 49, Courtney Co.

Bidens comosa is common throughout the Middle States and Mississippi Valley growing preferably in rather dry soil. Its usual habitat is along roadsides where the soil is rich, or on the sandy margins of lakes and rivers.

When growing undisturbed it often becomes so numerous as to form dense patches to which the pale upright stems and short branches give a characteristic appearance. Certain specimens however from widely separated localities (the Short, Hale and Werner specimens cited above, and others) present an entirely different aspect. The stems are decumbent at the base ; the leaves are shorter, blunter, more sparsely and bluntly toothed or the upper entire ; and the involucre of the long-peduncled heads is very foliaceous, with broad obtuse bracts. At first it seemed proper to separate this form as a distinct variety, but in the study of specimens from the vicinity of Ithaca similar plants were found but apparently always as a second growth after the main stem had been injured or cut away by the mower. It may be possible that the similar variation in *B. connata* is from a like cause. The same variation also occurs in the var. *acuta.*

B. comosa is distinguished from all other American representatives of the genus by its broad, 3-awned, retrorsely margined achene; from *B. connata* it differs also by its short branches, stout peduncles, pale leaves, very foliaceous involucre of usually more numerous bracts, and long pale 4-toothed corolla with included stamens; from *B. bidentoides* by the three downward-barbed awns and flat retrorse achenes; and from *B. cernuus* by the 5-toothed corolla, included stamens, 4-awned and angled achene, and by the erect heads. The flowering period is from September 1st to October 1st.

Its closest affinity is however with *B. tripartita integra* Koch (3-awned) a native of central Europe. This variety can be distinguished from the "second growth" American plants only by the slightly shorter involucre, smaller, slightly narrower, and thicker achenes with shorter awns. Through *B. tripartita* the American plant is connected with *B. frondosa* and *B. connata*, and through *B. platycephala* of Europe with *B. cernua.*

6. **Bidens dentata** (Nutt.)

B. chrysanthemoides Hook. Fl. Bor. Am. **1**: 314. 1833. (According to T. & G.) Not of Michx.

B. quadriaristata dentata Nutt. Trans. Amer. Phil. Soc. II. **7**: 368. 1841.

B. cernua elata T. & G. Fl. N. A. **2**: 352. 1842.

Stem very stout (40–100 cm.), glabrous or sparsely hirsute, branches short or the upper longer and ascending: leaves pale, often very large (8–18 cm. long), broadly lanceolate, oblanceolate, or oval, acute or short acuminate, contracted at the nearly sessile base, coarsely serrate, incised or rarely even parted, upper leaves nearly as large: heads few (1–3), large and nearly sessile, broader than high (20 mm. diam.); outer involucral bracts about 8, linear to oblanceolate, usually longer than the head, very unequal, some often very foliaceous and incised, conspicuously ciliate below; inner bracts elliptic-ovate, acutish: ray flowers present, ligule one half longer than the disk, oval, pale yellow, the ovary broadly oblong, glabrous except the strongly retrorse margins, awnless: corolla of the disk flowers large (4–5 mm.) funnelform, gradually contracted below, 5-toothed, deep yellow: achenes large and rather broad (3 × 8 mm.), flat, glabrous, brownish, broadly cuneate, slightly contracted at the summit; margins sparsely retrorse with small barbs the lowermost of which are often erect, summit concave:

awns 4 (rarely 2) unequal, about one half the length of achene, retrorsely barbed.

British Columbia near Vancouver.

Specimens examined:—De Fuca, *Scouler*. N. W. Coast, in Gray Herb. from Hooker. Vancouver Island, *Macoun*, no. 73.

This very distinct species, although collected for the first time many years ago, is represented in the herbaria by only a very few specimens. The three cited above are quite similar in general appearance and are characterized by the numerous large pale leaves which are often conspicuously incised, and among which at the summit of the stem the one to three broad and nearly sessile heads are borne. These in form are much like those of *B. cernua*, but they are erect, the rays are pale and very short, and the involucre is more foliaceous. The achenes are however quite unlike those of *B. cernua*, but are so similar to those of *B. comosa* as to sometimes render it difficult to distinguish the two species from this character alone. In structural characters this species seems to stand almost intermediate between *B. cernua* and *B. comosa* on the one hand and between *B. cernua* and *B. frondosa* on the other. It resembles the *B. bullata* L. of Europe which however has rayless heads, hairy stem and leaves and always two-awned achenes.

7. BIDENS CONNATA Muhl. Willd. Sp. Pl. **3**: 1718. 1804. Pursh Fl. Am. Sept.; Torr. Fl. N. U. S.?

B. tripartita Bigelow, Fl. Bost. 294 [ed. 2].

B. petiolata Nutt. Jour. Acad. Philad. **7**: 99.

B. tripartitus var. *fallax* Warnstorf, Verh. d. Bot. Verein d. Prov. Brand. **21**: 157. 1879.

B. decipiens Warnstorf, Oesterr. Bot. Zeitschr. **10**: 392. 1895.

Stems tall and moderately branched (5–14 dm. high), glabrous and purplish, internodes rather long, branches usually spreading: leaves undivided or some of the lower ones deeply parted near the base, lanceolate, elliptic-lanceolate, or elliptical, large (12–35 mm. × 70–130 mm.), acuminate, tapering at the base, coarsely and saliently serrate with sharp teeth, bright-green, the petiole slender (2–4 cm. long), scarcely margined, or sometimes short and margined: heads of medium size, slightly broader than high (broadest 15 mm.), on rather short peduncles; outer involucral bracts 4–5, linear or spatulate, rarely much exceeding the disk, not ciliate; inner bracts about 8, brownish, oblong-ovate to elliptic-oblong, mostly obtuse (7–8 mm. long): ray flowers rarely present, ligule golden-yellow, oblong, one half longer than the disk, ovary short and broad, awnless, hairy: corolla of the disk flowers of medium size (2.5–3.5 mm.), equaling the awns, upper portion oblong, 5-toothed, abruptly contracted into a lower portion which is as long as the upper: stamens exserted: mature achenes (4–6 mm. long), cuneate, very slightly contracted at the top, outer 3-angled and often 3-awned, inner 4-angled and 4-awned, dark-green or black, covered with brown or yellow warts, slightly hairy, barbs on the margins either erect or retrorse even upon the same achene, summit slightly convex; awns ⅓–½ the length of the achene, downwardly (rarely upwardly) barbed.

Massachusetts and New Hampshire to Virginia and westward to Missouri and Minnesota.

Specimens examined from:—Massachusetts: *Rich*, *Collins*, *Boott*, *Williams*, *et al.* New Hampshire: *Deane.* Rhode Island: Providence, *Thurber.* Connecticut: *Eaton* (with rays). New York: *Townsend*, *Vail*, *et al.* (many from Ithaca). Ontario: Lake Erie, *Macoun*; St. Catharines, *McCalla.* New Jersey: *Torrey*; *Nash.* Virginia: *Curtiss.* Ohio: *Selby*, no. 6 (up-barbed). Illinois: *Wolf*, no. 155; *Hall.* Missouri: *Bush*, no. 36. Minnesota: *Taylor.*

BIDENS CONNATA PINNATA Watson, A. Gray, Man. Bot. 284. 1890 [ed. 6].

Stem rather stout (40–70 cm.), much branched from near the base: leaves pinnately divided into from 4 to 6 pairs of narrowly linear (10–20 mm. long), acute, entire or incised distant divisions: heads numerous, similar to the type; chaff reddish tipped: achenes small, blackish, nearly smooth; awns slender, downwardly barbed as are also the margins of the achenes.

Vicinity of St. Paul, Minnesota.

Specimen examined: Richfield, Minn., *Couillard*, (type). (Also Ramsey Co., *Sandberg*, Minn. Bot. Stud., p. 572.)

Bidens connata is apparently confined entirely to the Northern States and is not found in the South as has heretofore been supposed. The southern plant seems in all case to be *B. comosa* instead. *B. connata* is very common throughout New England, the Middle States and the Mississippi valley, growing preferably in very wet soil, and is characteristic of ditches and wet swamps.

This species is one of the most variable of the whole group almost all portions of the plant being subject to change. In New England the leaves are shorter petioled, while in the West the petioles are often very long (4 cm.). Some specimens from the Eastern and Middle States have much narrower, nearly sessile leaves. Specimens from Ithaca, N. Y., and Ohio (Selby) as well as one in the National Herbarium collected by Dr. Vasey near Washington have upwardly barbed awns but other characters the same as in the type. At Ithaca these upwardly barbed plants grow over a considerable area almost to the exclusion of the normal form ; but many transitional specimens were found in which the awns bore barbs extending in either direction. In addition to these variations one often finds in sphagnous bogs and especially on decaying logs along the borders of lakes, pools and slow-flowing streams a very small form (5–20 cm.) bearing one or two few-flowered oblong heads, and small, spatulate-oblong, petioled, nearly entire leaves. However, when the place of growth becomes more congenial it seems to pass directly into the normal form.

A very interesting form is the var. *pinnata* Wats. from Minnesota. It seems to have a very limited range, being confined to two or three localities in the vicinity of St. Paul. The pinnate finely divided leaves and smoothish achenes make it a very conspicuous plant and almost specifically distinct. The limited distribution at first suggested its being a hybrid ; but no other species is known that could give such a combination of characters with *B. connata*. It should be looked for in other districts of the West.

The question as to whether Muhlenberg's type was really this species or *B. comosa* is a somewhat perplexing one. It seems, however, to be now quite definitely settled that the present interpretation is correct, both from a study of the original description, and from specimens which Prof. Ascherson has compared with the Muhlenberg material at Berlin, and which the writer has had an opportunity to examine through the kindness of Dr. Robinson.

*B. connata** has in recent years found its way into Europe.

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* The literature upon the occurrence of *B. connata* in Europe is as follows :

Warnstorf, Verhand. d. Bot. Verein. d. Prov. Brandenb. **21** : 157. 1879. Oesterr. Bot. Zeitschr. **10** : 392. 1895 ; **12** : 475. 1895. Bot. Gaz. **25** : 58. 1898.

Ascherson, Verhand. d. Bot. Verein. d. Prov. Brandenb. **37** : L. 1895 ; **38** : LIII. 1896. **39** : XC. 1897.

First reported in 1879 by Warnstorf from a locality in Germany (as *B. tripartita fallax*), it was later found in other localities by the same person, and is now known to be widely spread over Central Europe. Along with it was found another *Bidens* identified as *B. frondosa*, then a novelty for Germany, but having many years previously been introduced into Italy. From the description given it is not quite clear whether this is our *B. frondosa* or *B. melanocarpa*, but probably the latter.

Bidens connata is closely related to *B. tripartita* of Europe and more remotely with *B. laevis*. In North America it is one of the most distinct of all species of *Bidens*. From *B. tripartita* it may be distinguished by its 4-awned and angled, tuberculate achenia, and orange flowers; from *B. laevis* by the tuberculate achenia, absence of rays and more petioled leaves; and from *B. melanocarpa* by the 4-awned achenia and usually simple leaves. The flowering period of this species is from September 1 to October 1.

8. BIDENS CERNUA L. Sp. Pl. 832. 1753

Also Willd. Sp. Pl.; Pursh, Fl. Am. Sept.; Bigelow, Fl. Bost.; Fl. Dan. *pl. 841*; DC. Prod.; Torr. Fl. N. U. S.; T. & G. Fl. N. A.; Gray, Synop. Fl. N. A.; Macoun, Cat. Can. Pl.

B. cernua minima Willd. Sp. Pl. **3**: 1717. 1804.

B. minima Huds. Fl. Ang. 310. 1762; L. Sp. Pl. 1165, ed. 2; Fl. Dan. *pl. 312*.

Pale throughout: stem rather low (20–70 cm., rarely a meter), erect, glabrous, stramineous or reddish, sometimes sparsely hispid; branches short, rarely exceeding the subtending leaves, decreasing in length down the stem: leaves long and narrow, undivided, lanceolate or linear-lanceolate, sessile and more or less connate by a broad base, only slightly contracted below the middle, acuminate, serrate with coarse acute spreading distant teeth (or in coast plants, with smaller teeth) (6–16 cm. long): heads very large especially in fruit (disk 1.5–2.5 cm. broad), broader than high, before anthesis erect, becoming strongly cernuous in fruit, on short rather stout peduncles (2–4 cm.), often appearing clustered; outer involucre about 1½–3 times the length of the disk, bracts 7–8, obtusish, unequal, entire, linear or linear-lanceolate, spreading or reflexed; inner bracts about 8, ovate-oblong or oval, acutish, olive-yellow; chaff rarely if ever colored: ray flowers usually present, ligule pale or bright yellow, about ½ longer than the disk, narrowly elliptic, obtuse, caducous, ovaries short and broadly-oblong, glabrous except the strongly retrorse margins, summit truncate and without awns: corolla of the disk flowers large (4–5 mm.), pale or deep yellow, longer than the awns, campanulate-oval above, very abruptly contracted into a lower portion which is longer than the upper, 5-toothed: stamens slightly exserted: achenes small (5–6 mm.), olive, narrowly cuneate, slightly dilated at the summit, glabrous, margins strongly, almost serrately retrorse-barbed, rarely tuberculate except on the margins, strongly carinate on both faces (almost 4-angled), carinae retrorse, summit convex; awns 4 (½ length of achene), straight, retrorsely barbed.

Nova Scotia (*Macoun*) and Canada to North Carolina, Missouri and westward to the Pacific coast.

Specimens examined from:—Maine: *Fernald* (bog form); *M. E. Hill, Parlin.* Canada: Port Arthur, *Britton;* P. E. I., *Macoun;* Quebec, *Berg;* Ont., *McCalla, Scott.* New Hampshire: *Deane, Robinson,* no. 400. Massachusetts: *Rich, Collins.* Rhode Island: *Thurber, Olney.* New York: *Kearney, Dudley, DeForest, DuBois, Townsend, Schrenk.* New Jersey: *Parker, Britton.* Delaware (? *Tatnall,* awns 2). Virginia: *Curtiss.* Maryland: *Shriver.* North Carolina: *Huger* (Waynesville). Tennessee: *Ruth.* Illinois: *Chapman, DeForest.* Missouri: *Engelman.* Lake Superior: *Loring.* Wisconsin: *Gillman.* Wyoming: *Nelson,* no. 1707. Montana: *Scribner,* no. 108. Saskatchewan: *Bourgeau.* Oregon: *Lyall.* Washington: *Suksdorf,* no. 1592. British Columbia: *Macoun,* no. 458. California: *Michener* and *Bioletti.*

Bidens cernua elliptica var. nov.

B. cernua, in part, of many authors.

B. chrysanthemoides Pursh, Fl. Am. Sept.; Torr. Fl. N. Y. (in part); Darl. Fl. Cest.; Macoun, Cat. Can. Pl.

B. chrysanthemoides var. δ T. & G. Fl. N. A. **2**: 353. 1842.

? *B. cernua Coreopsis* Willd. Sp. Pl. 1716. 1804; Pursh, Fl. Am. Sept.

? *Coreopsis Bidens* L. Sp. Pl. 908. 1753. In part.

Plant much larger than the type (.5–1.5 m.), and more bushy-branched, the branches often exceeding the leaves, those at the middle of the stem longest: leaves larger (10–18 cm. × 2–4 cm.), elliptic-lanceolate or elliptical, acuminate, conspicuously tapering toward the base which is but slightly connate, more evenly and closely serrate: heads as in the type but more numerous: rays variable but commonly longer than in the type (1½–2 times length of disk).

Massachusetts to Kentucky, and westward to Kansas and the Pacific coast.

Specimens examined from: — Massachusetts: *Tuckerman, Faxon, Chambers, Swan, Collins, Young, Frohock.* Connecticut: Eaton. New York: *Stewart, Wiegand.* New Jersey: *Haxamer* and *Maier.* Pennsylvania: *Brinton.* Kentucky: *Short, Kearney:* no. 475. Illinois: *Bebb,* Kansas, Riley Co., *Carleton.* Wyoming: *Nelson,* no. 2724. British Columbia: *Macoun,* no. 457. Washington: *Suksdorf,* no. 932, 933. Oregon: *Cusick.*

Bidens cernua integra var. nov.

Large and stout, resembling var. *elliptica,* but the large leaves are not so much narrowed at the broad connate base, and are minutely serrate or nearly entire.

Missouri and Nebraska.

Specimens examined:—Missouri: Jackson Co., *Bush,* no. 165 and no. 34. Nebraska: Hooker Co., *Rydberg,* no. 1697; at Ainsworth, *Clements,* no. 2920.

Bidens cernua is one of the most widely distributed species of the genus, and is found throughout Europe and Asia as well as across the entire northern portion of North America. It grows preferably in very damp situations or in water, and in most parts of the eastern United States may be found abundant in ditches, along the borders of wet swamps, and especially on the muddy banks of lakes and rivers.

It is exceedingly variable in stature, foliage and length of involucre and rays. Nnumerous specimens also connect the type with *B. laevis* by an almost complete chain of intermediate forms. The essential characters of these two species are almost exactly the same, and one must depend for specific distinction on those characters to which is due the difference in general appearance. However, certain lines can be drawn which are fairly distinct, and in the interest of clearness it seems much better to break up the group as has here been done.

The specimens representing the typical form resemble very closely those of Europe, although more commonly radiate. They are all plants of low or medium stature, having large, more or less clustered heads with rays scarcely longer than the disk, sometimes entirely wanting; and what is more important, long, linear-lanceolate leaves, broad at the base and acuminate, with distant teeth. The heads are somewhat paler in color and the lower are on short branches close to the stem.

The plants may flower when very small and dwarf. Such specimens usually have a large involucre and shorter more entire leaves. In addition, there is a bog form analogous to the one described under *B. connata*. These plants grow on floating logs and in *Sphagnum*, and are very dwarf (4–14 cm.), with very small (2–4 cm.) spatulate entire leaves. On the other end of the log, however, may be larger specimens easily recognized as normal. This form is possibly the *B. minima* of Hudson, but in this country at least it is evidently not to be distinguished from the type.

A comparatively distinct form has been separated as var. *elliptica*. The large size of the plant, the broader leaves tapering at the base and closer serratures together with the longer rays has led to its being included often with the next species, but a comparison of the specimens shows that it is much more closely related to *B. cernua*. The shorter rays and foliaceous involucre are the best characters by which it may be separated from *B. laevis*.

B. cernua, like many other species of the genus which enter the confines of Missouri, has undergone variation. The form here described as var. *integra* is very distinct in appearance, and constant enough to warrant its separation. The flowering period of *B. cernua* is from Aug. 10 to Oct. 15.

9. BIDENS LAEVIS (L.) B.S.P. Prelim. Cat. N. Y. 29. 1888.

Helianthus laevis L. Sp. Pl. 906. 1753. Pl. Gronov.

Bidens chrysanthemoides Michx. Fl. Bor.-Am. **2**: 136. 1803. Also of Willd. Sp. Pl.; DC. Prod.; Elliot, Fl. S. C.; Torr. Fl. N. U. S.; T. & G. Fl. N. A. var. α and γ.

Bidens quadriaristata DC. Prod. **5**: 595. 1836.

Coreopsis Bidens Walt. Fl. Car. 215. 1788.

? *Coreopsis perfoliata* Walt. Fl. Car.

Stem (.5–1 m. tall) glabrous, tinged with purple, erect, branches ascending, longer than the leaves and all borne above the middle of the stem: leaves simple, small or of medium size (7–13 cm.) lanceolate or more commonly elliptic-lanceolate, glabrous, scarcely paler beneath, more or less contracted toward the sessile base, rarely clasping, acute or short acuminate, serrate with small inconspicuous teeth, rarely the upper slightly connate: heads of medium size (disk 15–22 mm. broad) on long (3–10 cm.) slender pedicels, globular or rarely in fruit broader than high; outer involucral bracts 7–8, equaling or but slightly longer than the disk, bracts linear to spatulate-linear, slightly ciliate or glabrous, nearly equal, slightly fleshy, obtusish, appressed or spreading, often crisp-wavy in drying; inner bracts about 8, oval, stramineous, equaling the disk; chaff usually reddish-tipped: ray flowers present, the ligule very large (2–3 cm. × 8–14 mm.), elliptical or oval, rounded at the apex, golden-yellow: ovaries short-oblong, glabrous except the retrorse margin, summit truncate, awnless: corolla of the disk flowers deep-yellow, large (4.5–5 mm. long), equaling or exceeding the awns, campanulate-oval above, very abruptly contracted into a basal portion which is slightly longer than the upper, lobes 5, spreading: stamens long-exserted: achenes in fruit (6–9 mm. long) evenly cuneate from the summit, not dilated at the top, glabrous, flattish or rarely slightly carinate on one face, strongly and almost serrately retrorse on the margins, olive-green, convex at the summit: awns 2–4, ½–⅔ the length of the achene, downwardly barbed.

Massachusetts to Georgia (?) along the coast, and in Central New York. Possibly also in Mexico.

Specimens examined from:—Massachusetts: *Boott;* Essex Co., *Oakes;* Dedham, *Harris;* Acton, *Swan;* Andover, *Young;* Rhode Island: *Thurber.* New York: Cayuga Marshes, *Clinton;* Oswego Co., *Rowlee;* Torr. Herb. (N. Y. ?). New Jersey: *Poggenburg* (?); Hudson Co., *Hexamer* and *Maier* (anomalous); *Brinton.* Delaware: *Britton, Tatnall.* Virginia: *Hollick* and *Britton.* North Carolina, *Dinwiddee* at Raleigh.

B. laevis as here limited contains a group of very similar forms. They are characterized by a more slender habit than *B. cernua*, and more ascending branches all near the summit of the stem; the leaves are smaller, the involucral bracts decidedly shorter and thicker, and the achenes are less strongly carinate; but what is still more important, the whole plant when in flower has a distinctly helianthoid appearance quite distinct from *B. cernua.* The character as to whether the heads are cernuous or not is of somewhat questionable value. In the present species they are often slightly nodding in fruit. Many specimens named *B. laevis* in the herbaria are simply plants of *B. cernua* just coming into flower at which time the heads of that species may also be erect.

Recent botanists have substituted the name *B. laevis* L. for the *B. chrysanthemoides* of Michaux. Whether this should be done or not depends on one's attitude regarding the interpretation of Linnaean names. The recent practice has been to interpret the species of Linnaeus as far as possible by his citation of the older authors; and indeed in many cases this is the only way in which the species can be recognized. But in this case it is found that while the unusually long description of *Helianthus laevis* is contradictory to a conception of *Bidens*, the figure of Gronovius there cited represents without doubt the *B. chrysanthemoides* Mx. However, notwithstanding this contradiction, it seems preferable even here to apply the custom of interpretation by citation, and consequently the name *B. laevis* has been used in this paper.

B. laevis is really a coast plant and except in one or two instances seems never to penetrate far inland. The New York. specimens indicate that this species also is a member of the little community of coast plants growing isolated in Central New York, and of which *Listera australis* is a member. The most southerly specimens examined were from North Carolina, but it seems probable that the species extends even as far as Georgia. The flowering period is from August 15th to October 5th.

Although this species normally has an involucre scarcely exceeding the disk, two or three large coarse plants with leaves 16 cm. long from New Jersey (Centre Square, *Brinton*), and Delaware (Wilmington, *Tatnall*) have bracts approaching those of *B. cernua* in length and foliaceous character; but the achenes are of *B. laevis*.

10. BIDENS NASHII Small, Bull. Torr. Bot. Club, **25**: 481. 1898
B. chrysanthemoides var. β, T. & G. Fl. N. A. **2**: 353. 1842.

Plant tall and rather stout (30–80 cm.), glabrous and more or less succulent, simple or with a few short erect branches near the summit; internodes often long: leaves ascending thickish (5–12 cm. × 20–35 mm.), oblong-lanceolate to oblanceolate-oblong, broader than in *B. laevis*, from barely acute to acuminate at the apex, slightly contracted toward the broad sessile, but scarcely connate base which in the upper leaves is very broad; veins inconspicuous, margins serrate with very fine teeth or nearly entire: heads few or often solitary (disk 15–20 mm. broad), erect or slightly nodding on long erect peduncles (2–7 cm.); outer involucral bracts 8, nearly equal, not exceeding the disk, fleshy, linear to linear-spatulate obtuse, glabrous, appressed or spreading; inner bracts oval acutish; chaff yellow: ray flowers present, ligules very large (15–35 mm. long x 10–12 mm. wide), elliptic, obtuse, deep-yellow; ovaries oblong, glabrous except the retrorse margins, truncate and without awns: corolla of the disk flowers large (4 mm.), deep yellow, equaling the awns, oblong-campanulate above, abruptly contracted into a slender basal portion, 5-toothed: stamens long-exserted: achenes in fruit small (5–6 mm.) narrow, cuneate, slightly contracted at the truncate or concave summit, flat, 1-nerved on outer face, margins retrorse, almost serrate: awns 2–3 (⅔–¾ length of achene), erect, retrorsely barbed.

Florida to Southern California.

Specimens examined from:—Florida: *Chapman*, *Nash*, Leon Co., no. 2336. Louisiana: *Hale*, no. 403 (type of T. & G. var.), *Carpenter.* Texas: *Lindheimer*, no. 435; Rio Grande, *Schott.* California: San Bernardino, *Wright;* Los Angeles, *Brewer*, no. 91; San Francisco, *Bolander*, no. 2405.

The three specimens of this species cited by Dr. Small in the original description, from Florida and Louisiana, differ from the Californian and Texan plants only in the less acute leaves, while the essential characters remain the same.

As appearing in the herbarium this species is quite different from *B. laevis* in general appearance, due mostly to its fleshy character, small serratures and broad leaf base. The achenes also seem to be slightly narrowed at the top and truncate after the manner of *B. connata.* The differences seem constant enough to warrant its recognition as a species.

CORNELL UNIVERSITY.

Studies in the Asclepiadaceae.—IV

By Anna Murray Vail

I. NOTES ON SOME OLD TYPES, WITH DESCRIPTIONS OF NEW OR LITTLE KNOWN SPECIES

Asclepias scaposa Vail, Bull. Torr. Bot. Club, **25**: 171. 1898

On a specimen of this species in Wright's New Mexican collection, no. 1683 in part, preserved in the Herbarium of the British Museum, I was fortunate to find a somewhat mature but complete flower, which through the courtesy of Mr. James Britten I was permitted to examine closely, so that to my former description I am able to add the following:

Corolla-segments 5 mm. long, apparently white; column short and broad; hoods of the corona barely exceeding the anthers, 2–2.5 mm. high, white or whitish, slightly pendulous or saccate at base, 5-dentate at the apex; central tooth rounded, the intermediate teeth acutish, the two ventral ones infolded, erect, slender, attenuated, nearly twice as long; horn arising from about the middle of the hood, slender, exserted; anther-wings salient and somewhat rounded at the base, apparently entire.

In floral structure allied to *A. quinquedentata* Gray and to *A. Palmeri* Vail, but its low habit and solitary terminal peduncle are, with few exceptions, rather unusual in the genus. I have seen only four specimens of it, the one in the Herbarium of Columbia University (Wright, no. 1684 in part), a fragment in Herb. Gray from the same collection (no. 1683 in part), the specimen mentioned above, and the one referred to below. In the first three cases it has been distributed with *A. longicornu* Benth. and *A. parviflora* Willd. (*A. perennis parvula* Gray). The fourth specimen is in the Herbarium of the Missouri Botanic Garden and is on a sheet with a specimen of (probably) *A. longicornu* Benth. in fruit only, the label bearing the following inscription: "No. 7, *Ascl. longicornu*, Wright, 1851."

Asclepias parvula (A. Gray)

Asclepias parvifolia Willd.? Torr. Mex. Bound. Surv. 164. 1859. Not Ait. 1789.

Asclepias perennis var. *parvula* (A. Gray) Proc. Am. Acad. **12**: 70. 1876.

Asclepias nivea Hemsl. Biol. Centr. Am. **2**: 325 and **4**: 69. 1881–2. Not Linn. 1753.

Pale gray-green throughout. Stem woody at the base, 3 dm. high, or more, erect, pubescent, often branched above: leaves short-petioled; blades lanceolate or oblong-lanceolate, tapering at each end, 4–6 cm. long, rather thick and coriaceous, glabrous or minutely puberulent above, puberulent beneath on the veins and revolute margins: peduncles 3–9, terminal and lateral, 1–4 cm. long; umbels 10–20-flowered: corolla white, small; column slender; hoods hastately sagittate at the base, not exceeding the anthers; horn falcate, thin, exserted, inflexed over the anthers: anther-wings narrow, entire at the salient base: follicles slender-fusiform, tapering to each end, 7–9 cm. long, glabrous: seeds 7 mm. long, red-brown, very thin, glabrous; coma 2–3 cm. long, abundant.

Mexican Boundary Survey, Head of Rock Creek, Bigelow, July 7, 1852; "*New Mexico*," Wright; *Texas:* Havard, Neally; *Mexico:* Palmer, no. 812.

The Wright specimen [no. 1684 in part] enumerated here is in the Herbarium of Columbia University. No. 1683, also of Wright's collection, contains besides *A. parvula* some specimens of *A. longicornu* Benth. (the plant since described as *Podostemma Emoryi* Greene, Pitt. **3**: 237), and some specimens of *A. scaposa* Vail.

Stelmagonum ? Holtonii

A low perennial herb. Root slender, vertical: stems slender, twining above, granular-puberulent and thinly hirsute with stiff spreading hairs, the lower portion with small corky-barked ridges: leaves opposite, on slender, granulose-puberulent and hirsute, 1.5–2.5 cm. long petioles; blades ovate-cordate, 3–4 cm. long, 1.5–2 cm. wide, acuminate at the apex, basal lobes rounded with narrow open sinus, granular-puberulent and with a few scattered short stiff hairs above, granular-puberulent and with more numerous stiff hairs beneath, especially on the veins, margins ciliate: flowers 4–7 in short-peduncled bracteolate cymes: peduncles axillary, 3 cm. long; pedicels 4–5 mm. long, the bracteoles subulate, very small, persistent: calyx 5-parted to below the middle, 2–3 mm. long, granular-puberulent and ciliate; segments acuminate, with an erect subulate gland in each sinus: corolla campanulate, 7–8 mm. long ? or more, 5-parted to a little below the middle, minutely granular-puberulent on the outer surface; segments oblong, obtuse, glabrous within; crown cohering to the corolla and to the raised gynostegium, cup-shaped, 5-lobed, each lobe abruptly contracted into a slender, linear 1 mm. long, erect ligule: stigma rounded, scarcely depressed: pollinia orbicular, horizontal or ascending on rather broad, winged caudicles; corpuscle nearly rhombic. Follicles not seen.

New Grenada: Goudot; Flora Neogranadina-Magdalena, I. F. Holton, Opia, no. 461, Dec., 1852.

Both of these specimens are in the Kew Herbarium and a duplicate of the Holton number is in the Herbarium of Columbia University.

Mellichampia ligulata (Benth.)

Enslenia ligulata Benth. Pl. Hartw. 290. 1848.

Mellichampia rubescens A. Gray; S. Wats. Proc. Am. Acad. **22**: 437. 1887.

For some time past I have suspected the identity of *Mellichampia* with *Enslenia ligulata* and through the courtesy of the Director of the Royal Gardens at Kew, I have obtained a tracing of the type of the latter plant which confirms the suspicion. Besides the type from Aguas Calientes, South Mexico, it has been collected in the State of Jalisco, at Guadalajara, by Dr. Palmer, no. 280, July–October, 1886, and by C. G. Pringle, in copses near Guadalajara, no. 5432, Aug., 1893. Mr. Hemsley (Biol. Centr. Am. **2**: 358) also quotes a specimen without locality from Herb. Pavon as belonging to this species. The specimens distributed as *Enslenia ligulata* by Pringle (no. 4494) and *Ampelamus ligulata* by A. A. Heller (no. 1899) are species of *Roulinia.*

II. THE TYPES OF GONOLOBUS MICHAUX AND DESCRIPTIONS OF NEW SPECIES IN VINCETOXICUM WALTER

The types of the three species of *Gonolobus* (Michx. Fl. Bor. Am. **1**: 119) are preserved in the Herbarium of the Museum in the Jardin des Plantes, Paris, where they are represented by several specimens each, all in a somewhat fragmentary condition, though quite recognizable and agreeing with the descriptions. In the Richard Herbarium (Herbarium of M. Drake del Castillo, Paris) the actual specimens owned and described by Richard in the Fl. Bor. Am. can be seen and they are in every way exact duplicates of the plants in the Michaux Herbarium proper, but are apparently more carefully labeled and named than those in the Museum. These last were annotated by Dr. Gray. The first sheet there has as inscription "*Cynanchum macrophyllum capsulis angulosis*" and is apparently the plant previously named *Vincetoxicum gonocarpos* Walt. and the plant which Dr. Gray (Proc. Am. Acad. **12**: 75) recognized as *Gonolobus laevis* var. *macrophyllus*. The specimen in the Richard Herbarium has the name "*G. macrophyllus*" and habitat "*In silvis Caroliniae*" on the sheet and is the same plant as the one in the Herb. Michaux.

The second species, *Gonolobus hirsutus*, is more difficult of determination as of course I was not able to make a dissection of the flower and the species is not so readily recognized as the first. There are muricate follicles in both collections and in Herb. Richard two racemes, one dark purple and the other very faded, dull greenish and shrunken; the leaves are large and the plant could be referred as readily to *G. Carolinensis* as to *G. hirsutus*. It is apparently identical with the plants that have been named *G. hirsutus* var. *flavidulus*. (See plants collected by Dr. Mellichamp at Bluffton, S.C., and so named by Dr. Gray). Since seeing these types, I have examined a long series of the *G. hirsutus* and var. *flavidulus* and also *G. Carolinensis* and have come to the conclusion that it will take very critical study and much more material, especially fresh material, to determine whether there are really two species there or only one. The coronal characters are difficult to reach in the dried plants and in the specimens which have passed through my hands I have found every form of crenation, both regular and irregular and great variation in the thickness of the crown-margin and also numerous instances in which the thickened alternate crenations have a very pronounced horn-like process within. Sometimes these last characters showed themselves in all stages of development from a faint obscure ridge near the apex of the crown-segment to a sharply incurved tooth. These again were to be found on one or two of the segments and again on every one of them. So far as I have been able to note, these characters are constant on the same plant. In some specimens the crown is uniformly thin, entirely lacking the alternate thickened divisions of the descriptions, others again have the thin geminate teeth claimed for *G. Carolinensis* and the quadrate alternate divisions belonging to *G. hirsutus.* It seemed entirely impossible with the material at hand to draw any fast or hard line between them. The pollinia that have very marked characters in the other species seem to be about the same in these two species and I could not find any differences between those of the flowers labeled *G. hirsutus* and of those called *G. Carolinensis.*

These two Michauxian species constituted the older genus *Vincetoxicum* of Walter which leaves the third species *G. laevis* as the type of the genus *Gonolobus.*

The type of *Gonolobus laevis* is somewhat of a curiosity. There is quite a good deal of it, small pieces mostly, but all of the specimens in the two collections agree and point unmistakably to the plant since called *Enslenia albida* Nutt. (*Ampelanus albida* Britt., Bull. Torr. Bot. Club, **21**: 314). In the Michaux Herbarium there are on a sheet a small specimen of *G. suberosus*? (the name and query are in Dr. Gray's* handwriting), one angled follicle and one raceme, noted as *G. laevis*, also by Dr. Gray, and two more leaves and two follicles. The old labels read "*Cynanchum capsulis laevis*" and "*Gonolobus laevis, Illinois.*" In the Richard Herbarium the specimens, consisting of some leaves and one angled follicle, are much worm-eaten. They are all, except the fragment of *G. suberosus*, *Enslenia albida.* This will clear up the discrepancy of the original description of *G. laevis* with the plants that have passed as such. "*Foliis quasi conoideo-cordatis, sensim acutis nervis tantum minutissime puberulis*" describes certainly the leaves of *Enslenia albida*, but scarcely accurately those of the so-called *Gonolobus laevis.* The synonymy of this plant should therefore be as follows:

GONOLOBUS LAEVIS Michx. Fl. Bor. Am. **1**: 119. 1803

Enslenia albida Nutt. Gen. Am. **1**: 164. 1818.

Ampelanus albidus Britton, Bull. Torr. Bot. Club, **21**: 314. 1894.

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* *Gonolobus suberosus* and *G. macrophyllus* are very close in general appearance, though the former has commonly yellowish-green leaves, with truncate base, and the latter darker green leaves that have notably large rounded basal and often overlapping lobes.

The type of this species is from Illinois, where it is not infrequently met with on river-banks and in thickets. It has a wide range, eastward and southward. The specimen quoted from Washington, D. C., as *Vincetoxicum gonocarpos laevis* in Britton & Brown, Illustrated Flora, **3**: 18, is in fruit and is the true *Gonolobus laevis* Michx. (Herb. Columbia University).

A second species **Gonolobus volubilis** (*Nematuris volubilis* Turcz. Bull. Soc. Nat. Imp. Mosc. **21**: 254. 1848. *Enslenia volubilis* Karst. Fl. Columb. **2**: 117. Pl. 162. 1866) occurs near Pt. Cabello, U. S. of Colombia.

VINCETOXICUM SUBEROSUM (L.) Britt., Mem. Torr. Bot. Club, **5**: 266. 1894.

Cynanchum suberosum L. Sp. Pl. 212. 1753. Dill. Hort. Elth. 300. *pl. 229. f. 296*, excluding Hort. Cliff. and Gron. 27.

Gonolobus suberosus R. Br. Ait. Hort. Kew. ed. 2, 82. 1811.

Dr. Gray * has written the history of this species and in addition to his notes it may be of interest to point out that the plant "*Apocynum scandens fruticosum fungoso cortice Brasilianum.*" Herm. Parad. 53 is probably the plant since referred to *Ibatia*, and is not the specimen of the Hortus Cliffortianus which resembles it only as to the corky, ridged bark of the stems. The Cliffort plant can be seen in the Herbarium of the British Museum and is difficult to identify as it is a mere fragment, but the character of the stem should make it easily recognizable were there more available material of the same species for comparison.

I venture to describe the following species as new.

Vincetoxicum Floridanum.

Puberulent throughout. Stems very slender, hirsute with few short, scattered hairs: leaves opposite; petioles 5–20 mm. long, angled; blades ovate, 2–5 cm. long, cordate, tapering to the acuminate apex, the basal lobes rounded, with open sinus, about equally puberulent with a fine soft pubescence on both surfaces; midvein obscurely bi-glandulose at the base above: racemes about the length of the petioles; pedicels 12 mm. long: calyx very small; segments 2 mm. long, linear-lanceolate, with a subulate gland in each sinus: corolla dull greenish-purple, 5-parted to a little below the

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* Proc. Am. Acad. **12**: 75. 1876.

middle; segments linear-lanceolate, acute, 3–5 m. long, somewhat fleshy, minutely puberulent, on the outer surface, glabrous within; crown red-purple, saucer-shaped, with 5 broad undulations each bidentate at the callous thickened apex, and a smaller tooth on each side below the middle: stigma depressed, not 5-angled: pollinia oblong, the caudicles broad and apparently not twisted? Follicles not seen.

East Florida: Dr. Leavenworth.

The specimen from which this description has been drawn is in the Herbarium of Columbia University and was labeled by Dr. Torrey, *Gonolobus* "*macrophyllus.*" It was seen by Dr. Gray when he was working on the Asclepiadaceae for the Synoptical Flora and bears his note to the effect that it has "short denticulate lobes" and on the Synoptical Flora label the doubtful one of "seemingly *Gonolobus Carolinensis.*" It differs however from that species, as elsewhere ticketed by Dr. Gray in its much smaller, greenish flowers, and the crown which has not the regular divisions of that of *Vincetoxicum Carolinensis*, but especially in the inflorescence which is irregularly racemose, whereas that of *V. Carolinensis* is more cymose and much longer pedicelled.

Vincetoxicum crenatum

A twining vine. Stems somewhat angled, papillose-puberulent and retrorsely hirsute with scattered short hairs: leaves opposite, on slender, striate, 3–5 cm. long petioles; blades yellowish-green, 6–9 cm. long, ovate, rather long-acuminate at the apex, cordate, basal lobes rounded with open or closed sinus, papillose-puberulent on both surfaces, paler beneath: inflorescence sub-corymbose; peduncles 5–8 cm. long, 4–10-flowered; pedicels slender, 8–15 mm. long, 1–2 bracteolate at base: calyx-segments ovate, acutish, puberulent outside, ciliate, glabrous, and with a subulate gland in each sinus within: corolla 13–14 mm. long, dull yellowish purple, rotately spreading, ovate-conic in bud; segments linear-oblong, acutish, puberulent outside, glabrate within and vertically reticulated, sparingly and minutely hirsute below the sinus, transversely wrinkled and glabrous in the short tube: crown shallow, saucer-shaped, 5-crenate; lobes rounded, not exceeding the anthers, each with a short, barely free internal process or appendage at about the middle; process truncate at the apex: stigma 5-angled, not depressed: anther-appendages small, fleshy; pollinia obliquely semi-orbicular, saccate and broader at the summit, dented at the angled base, caudicles and corpuscles short. Follicles not seen.

Mexico: Barranca near Cuernavaca, State of Morelos, Pringle, no. 6388, July 27, 1895.

Distributed as *Gonolobus pilosus* Benth. Resembling in habit *Gonolobus angustilobus* Rob. & Greenm. (Proc. Am. Acad. **29**: 388. 1894) from the State of Jalisco, but differing in its yellowish-green foliage, the more numerous flowers and the curiously reticulated character of the corolla. The leaves of *G. angustilobus* are grayish-green, the flower appears to be solitary and the corolla is not at all reticulated. Detailed floral characters of this last species, owing to lack of material, are not accurately known.

In regard to the true *Gonolobus pilosus* Benth. (Pl. Hartw. 289. 1848) it is perhaps worth noting that a specimen collected by Dr. Coulter, in Mexico, no. 975, is preserved in the Herbarium of Columbia University. This number is quoted by Hemsley (Biol. Centr. Am. **2**: 333) as belonging to *Gonolobus pilosus* Benth. It coincides in every respect with the description of that species. The flowers are at least 3.5 cm. in diameter when open, and are of a dark, dull reddish-purple. The calyx-segments and bracteoles are over 13 mm. long, ovate, acutish and foliaceous. The crown is barely 5-parted, lacerate-denticulate along the whole margin, each division with an adnate, thickened internal appendage which is laciniate and barely free at the broadly quadrate summit. The pollinia are remarkably large, obliquely oblong, rounded at the base and somewhat saccate, slightly tapering to the curved caudicles; corpuscle broadly obovate at the apex, abruptly contracted to the much narrower rounded base. The hyaline anther-tips are conspicuously large.

Vincetoxicum Greggii

Gonolobus productus Torr. Mex. Bound. Surv. 165. 1859. In part.

A slender, twining vine. Stems minutely puberulent and hirsute with short scattered hairs: leaves opposite; petioles 5–15 mm. long; blades 1.5–3 cm. long, or more, ovate-hastate, long-acuminate at the apex, the basal lobes rounded with open sinus, rather thick, papillose-puberulent on both surfaces: inflorescence subcorymbose; peduncles 1.2 cm. long, 5–8-flowered: calyx 2 (?) mm. long, minutely hirsute; segments ovate-triangular, acute, with a subulate gland in each sinus: corolla subrotate, 6–7 mm. long;

crown 5-parted, to below the middle; segments thick and fleshy, broadly rounded at the apex, each with an internal ligulate horn or process arising from near the base, exceeding the anthers and incurved over them: stigma 5-angled: pollinia quadrate on slender, winged caudicles, corpuscle narrowly oblong. Follicles not seen.

"Slender vine-like plant, flower purplish," Cadena, Mexico, Dr. Gregg, May 8, 1847.

The specimen described here is in the Herbarium of Columbia University and was included by Dr. Torrey in his description of *Gonolobus productus* and was ticketed under that name by Dr. Gray when he revised the Torrey Collection for the Synoptical Flora. It is closely allied to **Vincetoxicum acuminatum** (*Gonolobus acuminatus* A. Gray, Proc. Am. Acad. **21**: 399. 1888–6) as well as to **V. productum** (*Gonolobus productus* Torr.) All three species belong in Dr. Gray's section *Chthamalia* and without careful dissection could scarcely be distinguished one from the other, except that *V. Greggii* has a more rotately spreading corolla than its congeners.

There are marked differences in the pollinia of the three species. In *V. productum* the pollinia are spreading and perhaps subpendulous, obliquely oblong, twisted (?) and somewhat bent or dented at the middle; the caudicles are apparently winged and the corpuscle is oblong, also appearing as if winged. The pollinia of *V. acuminatum* are more truly horizontal, subovoid, rounded on one side and straight on the other, on broad caudicles, with a broad corpuscle. *V. Greggii* has ovoid-quadrate pollinia, with very slender, somewhat twisted caudicles and a slender oblong corpuscle. In this last species the leaves are smaller than in the two others, the corolla is more rotately spreading, the crown is more deeply parted and the internal ligules are free and incurved over the anthers. The pollinia and crown characters of *V. Greggii* are also nearly those of *Gonolobus bifidus* Hemsley, but in that species the corolla is much smaller and truly rotate. In *V. acuminatum* the crown-segments are quadrate at the apex and the internal processes are short, barely free at the apex.

Contributions to a better Knowledge of the Pyrenomycetes—I: A Study of Miscellaneous Species.

By David Griffiths

(With Plates 365, 366)

The following paper results from a study of a portion of my recent collections in this interesting group of fungi, and consists mainly of species from the Northwest, where the greater part of my collecting has been done. Of the species discussed *Trematosphaera caryophaga* alone was collected east of South Dakota. The other species were either collected in South Dakota, Wyoming, or Montana, or cultivated upon herbage which was obtained from these states.

During my investigations several species have been cultivated which are not recorded here, because of their extreme peculiarity and consequent necessity of obtaining more information regarding them. Some very peculiar modifications have been found in species of the genus *Pleospora*, developed under artificial conditions. In one instance a small quantity of an evident species of this genus developed perfectly superficial perithecia having radiating septate appendages, the whole having much the appearance externally of a perithecium of *Erysibe*. I find that some species of this genus develop very satisfactorily at times after being dried for several months. One immature species collected on dead culms of *Poa Nevadensis* in the Big Horn Mountains in August, 1898, grew nicely on being placed in a moist chamber for a few weeks in March and April, 1899. If some method of inducing more of the *Pyrenomycetes* to become mature could be devised it would be a boon to the collector, for, if the experience of others in the least resembles mine they find about one half of their collections in this group either sterile or immature.

The species of *Sordaria* recorded here are of special interest for several reasons. So far as I am aware, four of them have not been recorded before for this country. If once found they can be cultivated very easily and made use of by the teacher in demonstrations. I know from experience that it is difficult for the young student to form a clear conception of how the asci and spores look within the perithecium although he actually sees them escape from it when it ruptures under the cover glass. With a good condenser one can make out the shape of the asci in these species quite well without rupturing the perithecium at all. This is especially true of such a polysporous form as *S. curvicolla.* I have in several instances been able to secure the perithecia of this species, before they were yet mature, showing one or two large asci protruding above the other younger ones, and having mature spores, while the others had only very young and imperfectly outlined ones within them. As the younger asci develop, the older ones rupture, and their spores escape through the ostiolum, forming a black globule on the top of the perithecium. This is also true, to a less degree, of the two species of *Melanospora.*

Melanospora Poae sp. nov.

Perithecia scattered or gregarious, superficial, thin, membranous, white turning to black and opaque, prolonged above into a curved or twisted beak once to twice the length of the perithecium, covered with long delicate flexuous sparingly septate hairs, 140–180 μ × 500–600 μ : asci broadly clavate, short stipitate, evanescent, without paraphyses, 10–13 μ × 26–30 μ : spores very variable, oblong or cuboidal with an apical grove and often flattened parallel to it, 4.5–5 μ × 5.5–6.5 μ. *Pl. 336. f. 24–26.*

This species has been cultivated on dead culms and leaves of *Poa Nevadensis* collected in the Big Horn Mts., near Buffalo, Wyo., Aug., 1898 (Williams and Griffiths). The culms and leaves were thoroughly moistened and placed in a moist chamber on the 14th of March. Mature perithecia were found on the 29th of the same month—a remarkably short time for the development of this class of fungi. In order to make certain that the perithecia were not already partly developed before the material was placed in the moist chamber, two other cultures were made in April. This time the material was carefully examined, moistened and placed on sterilized filter paper in a Petri dish. Quite a growth of mycelium extended from the culms and leaves over the paper, and the perithecia were again developed entirely distinct from the dead herbage. In neither culture have I been able to find conidia.

There are plenty of Hyphomycetous conidia, especially those of *Cladosporium* and *Alternaria*, but no connection has been traced with any conidial form found on the herbage used. Attempts have been made to germinate the ascospores without success. It is hoped that they will grow later in the season and that pure cultures can then be made.

Melanospora Townei sp. nov.

Perithecia superficial, scattered, thin, membranous, transparent, globular, covered uniformly with long straight or slightly wavy irregularly outlined hairs and surmounted by a cylindrical beak which terminates in a loose aggregation of straight or slightly wavy hairs of unequal length, white turning to light transparent umber and finally black, 225–300 μ in diameter; beak about equal to the diameter of the perithecium and 60 μ in cross-section: asci very evanescent, broadly clavate to obovate, short-stipitate, 8-spored, 30–40 μ × 60–75 μ: spores crowded, olivaceous, becoming dark and opaque, elliptical, 15–17 μ × 20–25 μ; the slightly projecting truncate apices, when viewed endwise, are seen to have a relatively large hyaline pore in the flat truncate ends. *Pl. 365. f. 19–22.*

At my request, Mr. J. R. Towne, of Aberdeen, S. D., sent me fresh material of *Salsola kali tragus* which was affected with various species of *Hyphomycetes*. This material reached me on the 19th of March, when it was placed immediately in a damp chamber and kept thoroughly moistened until the first of June. On the 9th of May the beautiful white perithecia of the above species appeared in abundance.

In about three days after the material was placed in culture there occurred a very luxuriant growth of a species of *Alternaria*. This completely covered the twigs with a dense black layer of spores and hyphae which promised to choke out anything else that might develop. About the 1st of May this ceased to grow and all of the twigs were then covered with a layer of dormant *Alternaria* spores. When the perithecia appeared they were produced perfectly superficial and loose on the top of these masses of spores. I was unable to trace any connection between them and any conidia or distinct mycelium, although some of them grew on the surface of the glass in close proximity to the twigs. All attempts to germinate these ascospores have thus far proved futile.

This species resembles *M. leucotricha* Cda. very much outwardly, except that the perithecia are less hairy and the ostiolum less fimbriated. The spores and asci are, however, decidedly different although about equal in size. Specimens from Rehm's Ascomycetes have slightly inequilateral spores with acute hyaline apiculi. I have not been able to find asci with mature spores in my specimens, but they are common in the European ones. The illustration of the ascus in this paper was made from one in which the spores were just beginning to change color, because of my inability to get the asci with perfectly mature spores out of the perithecia without rupturing them. In fact the asci of this species are much like those of *Sordaria curvicolla* as regards persistency. I have often found immature asci in perithecia which had a globular mass of mature spores on the ostiolum, showing that there is a succession of development correlated, I judge, with the large size of the fully formed asci as compared with that of the perithecium. Some of the asci become mature, rupture, and allow their spores to escape, thereby giving room for other younger asci to develop.

SORDARIA MINUTA Fckl.

Perithecia superficial, scattered, thin, membranous, white to fuscous, and so transparent that the spore-bearing area which occupies rather less than half the length of the perithecium can be readily distinguished, covered with short septate agglutinated hairs which are more prominent around the smooth, black, naked, conical, erect or curved apex, 140–180 μ × 360–510 μ: asci paraphyseate, cylindrical, with a contracted stipe one half the length of spore-bearing portion, 4-spored, 15–18 μ × 100–110 μ: spores monoseriate, elliptical, acutely pointed, olivaceous to black and opaque when mature, 13–14 μ × 16–22 μ, terminating below in a hyaline straight or slightly curved gelatinous appendage one half the length of the spore. *Pl. 365. f. 10–12.*

The asci are without exception 4-spored and uniseriate. Dr. Winter (Die deutschen Sordarien, Abhand. der Naturforsch. Gesell. zu Halle, **13**: 67–107. 1887) characterizes this species as having 4- or 8-spored asci. But he also finds in many of his collections and cultures of German specimens that one or the other form is quite constant, while in still other material the two forms are mixed.

Dead culms and leaves of *Poa Nevadensis* having on them imperfectly developed perithecia of some of the *Sphaeriales*, probably a *Pleospora*, were collected in the Big Horn Mts., near Buffalo, Wyo., at an altitude of about 8000 ft. in August, 1898 (Williams and Griffiths). On the 14th of April, 1899, this material was thoroughly soaked and placed in a moist chamber. On the 3d of May mature perithecia of the above were present in considerable numbers. They continued to develop for two weeks longer when the material became dry. No precautions were taken regarding heat and moisture, the culms and leaves being cut into appropriate lengths to fit in an ordinary 3 ½-inch Petri dish, thoroughly moistened, and kept at laboratory temperature of about 21° in another Petri dish of larger size.

SORDARIA CURVULA DeB.

Perithecia scattered, superficial but firmly attached by the base, conical, truncate, curved and blackened at the apex, thin, membranous, sparingly covered with septate fasciculated hairs which are more prominent around the base of the blackened apex, 275–375 μ × 500–700 μ, spore-bearing area easily distinguished by transmitted light, asci paraphyseate, cylindrical-clavate, stipitate, 8-spored, 25–35 μ × 160–200 μ: spores biseriate with the two lower spores of the upper series overlapping the two upper spores of the lower series in the center of the spore-bearing portion of the ascus, oval, 19–21 μ × 24–28 μ, abruptly but acutely pointed, olivaceous to black with a gelatinous hyaline appendage at the lower end varying from one half to once the length of the spore. *Pl. 365. f. 1–5.*

This differs in several particulars from *S. curvula aloides* Wint. as recorded for this country by Messrs. Ellis & Everhart in N. A. Pyreno. 129, and corresponds more closely with the typical European species. The main differences occur in the characteristics of the hairs and the serial character of the spores. When the asci escape from the perithecium under the microscope they often appear distorted, becoming inflated so as to render the ascus more or less oval in outline, but leaving the arrangement of the spores undisturbed. I have had this phenomenon occur in water, 2 % chrome-alum, and 5 % caustic potash. Dr. Winter describes and figures a similar phenomenon in his specimens.

Dead stems of *Salsola kali tragus* affected with a species of *Ophiobolus* were collected at Aberdeen, S. D., in March, 1898. On the

10th of March, 1899, these stems were placed in a moist chamber under conditions similar to those described above for *Poa Nevadensis*. Mature perithecia of this species were first observed on April 7th. Subsequent cultures from the same material show the perithecia to develop in about three weeks. It appears to thrive best in an abundance of moisture. I have succeeded in getting the best growth of it when the herbage was not only thoroughly moist but when the chamber in which they were placed had water standing in the bottom of it. This species has also been cultivated in small quantity on dead scapes and leaves of *Allium* from the Big Horn Mountains of Wyoming, treated in the same way.

SORDARIA CURVICOLLA Wint.

Perithecia scattered, semi-immersed, pyriform, thin, membranaceous, about 600 μ in diameter, outline of asci plainly distinguishable by transmitted light, the conical truncate black apex clothed with short, delicate, simple, brown hairs, asci broadly clavate, polysporous with few evanescent paraphyses, 100–120 $\mu \times$ 270–300 μ: spores oval, 10–11 × 14–15 μ, olivaceous to dark and opaque with a hyaline appendage at the lower end about ⅔ the length of the spore. *Pl. 365. f. 13–15.*

This species developed on *Salsola kali tragus* with *Sordaria curvula*, but I found none of it for about five weeks after the culture was started.

This differs from European specimens principally in the larger number of spores and their occasionally darkened apiculi. The latter is not invariable in my specimens and I apprehend that the former may be very variable in the species. Dr. Winter, after isolating an ascus in one of his specimens and rupturing it, counted 128 spores, but my specimens contain as many as 150 spores, a variation which I consider of minor importance. In other respects my specimens correspond very well with European specimens in Krieger's Fungi Saxonici, no. 33, as they do also with Dr. Winter's descriptions and figures.

I would not be surprised to know that this and the two previously described species are very common in this country although they have not been recorded before so far as I am aware. They are very liable to be overlooked by the collector. Indeed, it is with difficulty that I am able to find the perithecia in my cultures after they have become dry, although they are very numerous.

SORDARIA PLEIOSPORA Wint.

Perithecia scattered, with base slightly sunken in the soft substratum, covered especially above with the characteristic cellular agglutinated hairs of this group, together with a few long, delicate, simple, slightly flexuous, sparingly septate, brown hairs, and terminating in a curved, black, rounded or truncate beak, 450 μ × 600 μ: asci 28–32-spored, cylindrical-clavate, short-stipitate, 30–40 μ × 175–200 μ: spores oval, 12–15 μ × 18–21 μ, black and opaque with hyaline evanescent gelatinous appendage at lower end, about ⅔ the length of the spore. *Pl. 365. f. 6–9.*

The measurements of spores and asci given above are considerably at variance with the published descriptions of European forms. The species is also described with gelatinous apiculus at each end of the spore. The number of spores in an ascus is said to vary from 16–64, but my specimens vary within the much narrower limits quoted above. The gravest variations, therefore, are in spore measurements which are given by Winter as 16–19 μ × 24–34 μ. The variation in the size of the ascus is not so important in my estimation since the number of spores is so variable.

Associated with these species developed on *Salsola* stems I find an abundance of conidial forms resembling those which Winter found in his cultures. He, however, was unable to trace any connection between these conidial forms and the species of *Sordaria* with which it was associated and simply mentions it as a probable conidial form. He describes the hyphae as short, hyaline, continuous, with a bifurcate apex; and the spores as fusiform with attenuate base and rounded apex, continuous or obscurely uniseptate. In my material the spores are of two distinct forms both of which are evidently polyseptate. One form resembles those described above in everything but the septation of the spores while the other has long spindle-form spores resembling the former but pointed at both ends. Thus far I have found nothing that enables me to make any statement regarding their probable affinities.

SORDARIA FIMICOLA (Rob.) Ces. & DeNot.

This species developed on dead *Eleocharis* culms affected with *Pleospora aquatica* placed in moist chamber for 18 days. As it is described by Messrs. Ellis & Everhart in N. A. Pyreno., 127, it need only be mentioned here. *Pl. 365. f. 16–18.*

PERISPORIUM VULGARE Cda.

Perithecia superficial, scattered or gregarious and more or less angular from mutual compression, subglobose, carbonaceous, brittle, black and shining when mature, covered at first with a white tomentum which soon disappears, about ⅓ mm. in diameter: asci evanescent, broadly clavate, long-stipitate, 8-spored, 15–20 μ × 90–105 μ: spores 4-celled, 6–8 μ × 24–28 μ, brown, opaque, with the two end cells subconical and the two middle ones oblong-cubical, easily separating into separate cells. *Pl. 366. f. 15–18.*

This species is described and figured here for several reasons So far as I am aware, it has not been recorded before from this country, although figured and described by Messrs. Ellis & Everhart from European specimens. The specimens, which I have in good quantity, were collected by Mr. C. W. Williams, one of my former students, at Aberdeen, S. D., on sticks and straw in an old rubbish heap, March, 1898.

The ascospores germinate very readily and grow vigorously. The specimens from which the accompanying figures were made were cultivated from the ascospores of the material cited above. Ordinary filter paper was sterilized, placed in a Petri dish and moistened with a sterile decoction of ash leaves, and then inoculated with the ascospores. A delicate white mycelium was produced in abundance in a very few days, but careful search failed to discover any conidia. The perithecia became mature in six weeks. The spores (cells of ascospores) apparently have no regular method of germination, like those of the *Sordariaceae* or *Chaetomiaceae* for instance, but crack open irregularly to allow the promycelium to develop. Although the conditions were apparently favorable for mycelial development the perithecia were few and scattering in my cultures.

Pocosphaeria Allii sp. nov.

Conidial hyphae arising from a much branched torulous, knotted, brown, subepidermal mycelium, variously bent and knotted, 6–8 μ × 150–200 μ: conidia oval, 1–3-septate, brown, minutely echinulate, 11–14 μ × 24–30 μ: perithecia subglobose to hemispherical, 100–125 μ in diameter, erumpent, membranous, dark-colored with a thickened darker ring around the ostiolum; bristles around the thickened ostiolum black, smooth, straight to recurved: asci cylindrical, contracted below, sessile, usually more or less curved or inequilateral, 12–15 $\mu \times$ 50–60 μ: spores 3-septate, constricted at the septa, fusiform, brown, 5–8 $\mu \times$ 16–20 μ. *Pl. 366. f. 1–9.*

On dead scapes and leaves of *Allium brevistylum* in Big Horn Mts., near Buffalo, Wyo., Aug., 1898. (Williams and Griffiths.)

The method of development of the perithecia in this species is of interest. The conidial hyphae usually protrude through the stomata in tufts of 2–5, and the perithecia are developed as a proliferation of the cells at their bases. At first the hyphae arise directly from the hypodermal mycelium which can be easily seen in tangential sections, but the proliferation of cells at their bases soon gives them the appearance of arising from a pseudo-parenchymatous mass of fungous cells. The hyphae are carried upward by this mass of cells, and the stoma and surrounding tissues become much distorted. The hyphae appear to produce conidia for some time after the beginning of perithecial development as shown in the figures. These, however, finally disappear before the perithecium becomes mature, and bristles develop surrounding the central ostiolum. Unfortunately mature material is rather rare, but the conidial and transitional stages have been collected in good quantity.

Pyrenophora Salsolae sp. nov.

Perithecia aggregated, subepidermal, early erumpent, subglobose to flattened, black, carbonaceous, brittle, about 300 μ in diameter, covered uniformly above with short, brown to black, septate, slightly wavy fugaceous bristles: asci cylindrical, contracted below into a short-stipitate base, 3–8-spored: spores one- or two-seriate, ovate, muriform, 4–5-septate with two longitudinal septa, slightly flattened, yellow, 6–11 $\mu \times$ 20–26 μ. *Pl. 366. f. 30–34.*

The method of spore dissemination in this species is very interesting. There is near the middle of the ascus a transverse marking which is usually plainly visible. Sometimes it is simply a transverse line on the ascus wall, but more often it appears as a spiral of 1½ turns. When pressure is put upon the cover glass, the asci rupture on these markings, the top of the ascus shooting out for some distance, leaving in its wake the spores more or less deranged, but always in a long string imbedded in a gelatinous matrix, which does not remain attached to them when they are isolated. Often one may find in the field the top and bottom of an ascus separated by twice its original length, and the two parts connected by a string of spores imbedded in their matrix. The rupture of the ascus is brought about doubtless here as in many other ascomycetes by the tension within it, for the gelatinous material with its contained spores occupies two or three times its original volume when set free by the rupturing of the ascus.

This was cultivated on dead stems of *Salsola kali tragus* with the species of *Sordaria* described above. It developed in rather small quantity in eight weeks' time.

Trematosphaera caryophaga (Schw.)

Perithecia superficial with their bases slightly sunken in the thin, black, carbonaceous crust which covers the nut more or less uniformly, rough, black, carbonaceous, brittle, hemispherical, with papilliform ostiolum, 350 μ in diameter, asci evanescent, subcylindrical with filiform paraphyses, 10–12 μ × 55–75 μ : spores biseriate, oblong, narrowed and round at the ends, slightly inequilateral or curved, 3-septate with a darkened band surrounding the middle septum, 4–6 μ × 10–16 μ. *Pl. 366. f. 12–14.*

This species described by Schweinitz, Syn. N. Am. Fungi, no. 1594 Trans. Amer. Phil. Soc. Phila., 215, 1831, has been included by Messrs. Ellis and Everhart, North American Pyreno. 207, with *T. nuclearia* (DeNot) Sacc., published in Micr. Ital. **9** : 462, *f. 4*; but a very little study of the specimens from different localities is necessary to convince one that the American form growing on decaying shells of hickory nuts, is very different from the European form growing on olive pits. Had I but one specimen I might consider the species variable enough to produce the differences which are observable ; but the Pennsylvania specimens collected by Mr. Everhart and my own collected in the burrow of some rodent at Fort Lee, New Jersey, are remarkably constant in all their characters, even to the coloration of the spores. The main differences are those of size which are brought out in my figures (10 and 11, *pl. 366*) of these two species. The European species is larger throughout than the American—the perithecia measuring about 525 μ, the spores 6–8 μ × 18–21 μ. I have been unable to get out complete asci from the European specimens at hand (Roumeguère Fungi Selecti Gallici, no. 4783). The coloration of the spores differs markedly also. In the European specimens the spores are darker in color and the central band extends over all of the two central cells, while in the American ones there is a light streak between the dark band and the outside septa. The paraphyses are much less abundant in the European species.

In both species the dark band obscures the middle septum so that it is often difficult to determine whether the spores are really 3-septate or not. I find, however, that after soaking in glycerine for some time the central septum becomes more apparent. Its presence is sometimes indicated by a very slight constriction; in young spores it can be very distinctly seen.

Dothidea conspicua sp. nov.

Stroma immersed, irrumpent, surrounded by the lacerated remains of the ruptured epidermis, circular or oval, seldom confluent, flat, rough, black, ⅓–⅔ mm. in diameter: ascigerous cavities sunken, oval to conical and more or less angular from mutual compression, 50–60 μ × 100 μ: asci cylindrical-clavate, with a short, stout, blunt stipe, without paraphyses, 65–85 μ × 12–14 μ: spores sub-biseriate, unequally uniseptate, constricted, at first yellow, but finally dark and opaque, 5–6 μ × 13–18 μ. *Pl. 366. f. 19–23.*

On *Yucca angustifolia* at Billings, Mont., August, 1898. (Williams & Griffiths.)

Mr. J. B. Ellis described a *Phyllachora ? Yuccae* on *Yucca angustifolia* (Bull. Torr. Bot. Club, **22**: 440. 1895) collected by Dr. Egeling at Matamoras, Mexico. I thought at first that my specimen must be the fully developed condition of the immature species which he there describes; but the characteristics of the stroma alone are enough to separate it from the Mexican specimen, which also appears to me to be a *Dothidea.* The absence of paraphyses and the method in which the epidermis becomes ruptured and lacerated are also good characteristics which would separate the above described species from that described by Mr. Ellis. The nearest relative, however, of this species appears to be *Didymosphaeria yuccaegena* (Cke.) Sacc., Sylloge Fungorum, **1**: 708. This was originally described as *Sphaeria yuccaegena* Cooke, in Grevillea, **7**: 12. 1878, from specimens collected by Dr. Harkness on *Yucca communis,* at Sacramento, California. After the change in name made by Saccardo, cited above, Cooke in

Grevillea **18**: 28 wrote the species as *Didymosphaerella yuccogena* Cke. This species also may be a *Dothidea.* It certainly appears to have its asci produced in stromatic cavities without perithecia the same as the species here described; and the spores have the typical unequal septation of the genus *Dothidea* when young, but they become more nearly equal when mature. In the general appearance of asci and spores there is but little difference between this species and the one which is described above. A specimen in the Ellis Herbarium from Dr. Harkness shows the spores to be larger and the asci nearly twice the width at the base. These are the only differences in the microscopic characters. The method of growth is, however, decidedly different. The stromatic areas in my species are two to three times as large, prominently erumpent and surrounded by the lacerated remains of the ruptured epidermis; while in the other case the epidermis is unruptured although the specimens appear to be as fully developed as mine.

Pleospora aquatica sp. nov.

Perithecia scattered, subglobose to hemispherical, 140–180 μ in diameter, flattened when dry, subepidermal, remaining covered, membranous, black and smooth with flat indistinct ostiolum: asci cylindrical-clavate, curved, and often bent into a u shape, short-stipitate, without paraphyses, 22–29 $\mu \times$ 95–125 μ: spores oval, 10–12 $\mu \times$ 28–30 μ, slightly flattened, with 5 transverse and 2 to 4 longitudinal septa, constricted at all transverse septa and surrounded by a gelatinous hyaline covering which is prolonged into a short thick blunt appendage at either end. *Pl. 366. f. 27–29.*

This species was collected at Aberdeen, S. D., in May, 1896, on dead stems of *Eleocharis palustris* under water. The pond in which the collection was made, had been filled with artesian well water together with that obtained from natural drainage to a depth of not less than a foot since the previous season. I first discovered the fungus in April when it was immature. About a month later I visited the same locality again and found an abundance of it in the best condition possible. The pond contained from 2 to 2½ feet of water during the spring months and the culms of the previous year upon which the fungus grew were entirely submerged.

COLUMBIA UNIVERSITY, 1 July, 1899.

Explanation of Plate 365

1–3. *Sordaria curvula* DeB. Perithecium, ascus and spore.

4 and 5. *Sordaria curvula* DeB. Two germinating spores after 24 hours in water.

6–8. *Sordaria pleiospora* Wint. Perithecium, ascus and spore. Spores in ascus slightly deranged.

9. Hair from perithecium of *S. pleospora*.

10–12. *Sordaria minuta* Fckl. Perithecium, ascus and spore.

13–15. *Sordaria curvicolla* Wint. Perithecium, ascus and spore.

16–18. *Sordaria fimicola* (Rob.) Ces. & DeNot. Perithecium, ascus and spore.

19–21. *Melanospora Townei* sp. nov. Perithecium, ascus and spore.

22. Hair from perithecium of *M. Townei*.

NOTE.—All perithecia × 35, asci 230, and spores 315. Figs. 4 and 5 × 230; 9 and 22 × 315.

Explanation of Plate 366

1–9. *Pocosphaeria Allii* sp. nov.

1. Mature perithecia, × 50.

2. Young perithecium crowned with the conidial hyphae, × 230.

3. Conidial hyphae showing a slight proliferation of cells at their bases, × 230.

4. A single hypha projecting through a stoma, × 230.

5. Ascus, × 230.

6. Spore, × 315.

7. Conidiospores, × 315.

8 and 9. Mycelium as seen through the transparent epidermis, × 230.

10 and 11. *Trematosphaera nucleiara* (DeNot.) Sacc. from Roumeguère Fungi Selecti Gallici, no. 4783.

10. Perithecium, × 35. 11. Spores, × 315.

12–14. *Trematosphaera caryophaga* (Schw.).

12. Perithecium, × 35. 13. Ascus, × 230. 14. Spores, × 315.

15–18. *Perisporium vulgare* Cda.

15. Perithecium grown on paper in Petri dish, × 75.

16. Ascus, × 230. 17. Spores, × 315. 18. A single cell of ascospore after 24 hours' growth in water.

19–23. *Dothidea conspicua* sp. nov.

19. Portion of affected *Yucca* leaf, × 12. 20. Ascus, × 315.

21. Portion of a stoma, × 35. 22. Spore, × 315. 23. A stromatic cavity showing cellular structure, × 230.

24–26. *Melanospora Poae* sp. nov.

24. Perithecium, × 50. 25. Ascus, × 315. 28. Spores, × 480.

27–29 *Pleospora aquatica* sp. nov.

27. Perithecium, × 35. 28. Ascus, × 230. 29. Spores, × 315.

30–34. *Pyrenophora Salsolae* sp. nov.

30. Perithecium, × 35. 31. Two asci, one of which shows the spiral line of dehiscence. 32. An ascus slightly extended after rupturing. 33. Two asci, one of which shows a straight line of dehiscence. All × 230. 34. Spores, × 315.

Studies in Sisyrinchium—IV: S. angustifolium and related Species of the West and Northwest

By Eugene P. Bicknell

The simple-stemmed blue-flowered *Sisyrinchia* of the far west and northwest which have hitherto been referred mostly to *S. angustifolium* Miller in reality represent a group of distinct species. This appears unmistakably from a considerable collection of specimens brought together from various sources; but it is further evident from this same material that, largely by reason of its general deficiency in specimens with mature fruit, it forms a wholly inadequate basis for the confident segregation of the various forms.

The problem presented therefore is the reduction of this inchoate mass into some approach to natural order under conditions which make impossible a final and satisfactory result. In order to take any forward step in these circumstances it is necessary to proceed in great part on the individual judgment pending the final proof which a sufficient series of specimens can alone afford. Under the risk of error involved in thus attempting the disentanglement of the species, I have aimed rather to avoid the creation of any mere synonym than to define the exact nature of the differences between the forms recognized, whether varietal or fully specific. And a number of forms have been passed over entirely as appearing to have too uncertain claims to possible specific rank.

Sisyrinchium Idahoense sp. nov.

From 20–45 cm. high, pale green and glaucous, usually showing some discoloration in drying. Leaves from half to three quarters the height of the stem, grass-like, varying from thin and somewhat lax to firm and closely erect, and from 1–3.5 mm. in width, attenuate to somewhat abruptly acute, the edges serrulate or smooth: stem straight and erect or somewhat flexuously curved, frequently twisted, simple or occasionally bearing a leaf near the top subtending one or two short branches, 1–3 mm. wide, winged, the edges sometimes smooth but usually distinctly serrulate, or even hispidulous-aculeolate: spathes often deflected, green or faintly purplish, long and relatively narrow, the keels of one or both bracts often serrulate or hispidulous; outer bract 3–6 cm. long, commonly ¼–⅓ longer than the inner one, rarely twice its length, foliaceous and abruptly pointed or more slender and attenuate, the margins below narrowly hyaline, united for about 4 mm. at base; inner bract 2–3.5 cm. long, herbaceous, the margins narrowly hyaline, obtusely pointed or acute; interior scales mostly about ¾ the length of the inner bract; the spathes, when borne on branches, are shorter with less prolonged outer bract than when terminating the main stem: flowers 3–6 on erect pedicels 1.5–3 cm. long, deep violet-blue, with rather small yellow eye, large, perianth 12–18 mm. long, indicating an extreme spread of over 3.5 cm.; stamineal column 5–8 mm. high; ovary glandular puberulent: capsules globose or ovoid, 4–6 mm. high, rather thick-walled, turning dark; seeds (immature) irregularly obovoid, angled, rugulose, stipitate, about 1 mm. in longer diameter.

Idaho, Washington, Oregon and California. Meadows and moist grassy places, flowering in northern Idaho from the middle of May into July, in western Oregon about a month earlier.

Idaho: Kootenai Co., J. B. Leiberg, Geo. B. Aiton; Latah Co., L. F. Henderson; Nez Perces Co., J. H. Sandberg.

Washington: Whitman Co., A. D. E. Elmer, C. V. Piper; Chehalis Co., A. A. & E. Gertrude Heller.

Oregon: "Eastern Oregon," L. F. Henderson; Crook Co., J. B. Leiberg; Benton Co., A. Isabel Mulford.

California: Mt. Shasta, 6000 ft. alt., Geo. Engelmann; Yosemite Valley, H. Mann.

I find the labels on specimens of this plant variously inscribed with the names, *S. angustifolium*, *S. anceps*, *S. mucronatum* and *S. bellum*. On one sheet all four names appear in different handwritings, well illustrating the confusion that has prevailed in regard to the plant.

The species may be taken as the northwestern representative of *S. angustifolium* to which it is nearly related, differing in its typical state mainly in more ciliolate-serrulate stems, longer spathes with less unequal, more foliaceous bracts and much larger flowers; it is also, as a rule, less stiff and straight, the stems often somewhat curved; the spathes frequently deflected and enclosing longer membranous scales than in *S. angustifolium*. In the usual state of the latter the wings of the stem are manifestly widened into the base of the spathe; in *S. Idahoense* they are scarcely, if at all, so widened, but may be even slightly narrowed conformably with a joint-like transverse constriction where the raised line of the stem disappears as if pinched out below the base of the spathe. Suggestions of this character casually appear in *S. angustifolium* in which, however, as a rule, the raised line of the stem passes uninterruptedly into the stiff erect spathe.

Stouter, broader-leaved forms of *S. Idahoense* appear somewhat intermediate in aspect between *S. angustifolium* and *S. littorale* Greene, of Alaska. From the latter, however, the species differs essentially in its larger flowers and smaller fruit; it is also less stout, paler and more glaucous, with narrower leaves of thicker texture and less foliaceous and differently shaped inner bract.

The type specimens from northern Idaho, Nez Percés Co., have rather long and broad thin leaves, long foliaceous bracts and very large flowers. The capsules are 4–6 mm. high, and mostly obovate-subglobose often contracted to a substipitate base. Most specimens from Idaho and some from Washington agree closely with these, although other specimens are much slenderer and with smaller flowers. Some specimens from Oregon and Washington, somewhat doubtfully referred here, bear two peduncled spathes and have stiffer leaves, shorter often purplish spathes, apparently smaller flowers and rather larger more globose fruit on slightly more exserted pedicels. Other specimens, from western Oregon are noteworthy from having dried uniformly dark and for their long often flexuous and branched stems, and rather small somewhat obovate fruit. The specimens cited from California are both in poor condition, and though appearing somewhat aberrant are certainly nearer to *S. Idahoense* than to any other species now known.

Sisyrinchium occidentale sp. nov.

Mostly over 20 cm. high (15–35 cm.), stiff and erect, glaucescent to pale glaucous green, usually with a yellowish tinge, discoloring slightly in drying; roots clustered, usually coarsely fibrous. Leaves 1–2.5 mm. wide, firm and erect or sometimes thinnish, strongly or rather weakly close-nerved, very acute, the extreme tip often hardened in age, the basal remains of older leaves frequently becoming bleached and silvery: stems stiffly erect, usually much longer than the leaves, 1–2 mm. wide, wing-margined, the wings usually closely few-striate, the edges like those of the leaves very smooth, a slight transverse constriction just below the spathe: spathes erect or slightly deflected, green or faintly dull purplish, the bracts often thin and rather weak-nerved, the outer one mostly straight, the inner one more or less convex in outline; outer bract surpassing the inner 2–15 mm., mostly 2–3 cm. long, attenuate-acute, hyaline-margined below and united-clasping for 2.5 mm. at base; inner bract rather broadly hyaline-margined nearly to the apex, sometimes acuminate but usually broad above and abruptly acute or even scarious obtuse; interior scales rather broad, often nearly equaling the inner bract: flowers 3–6, medium to large, deep violet-blue on erect exserted pedicels; perianth 10–14 mm. long; stamineal column 4–6 mm. high; capsules (not fully mature) subglobose, brown, about 4 mm. high, apparently rather few-seeded, and glabrate or nearly so at maturity.

Idaho and Nevada to Colorado and North Dakota, flowering in June and July.

Idaho: Arco, June 18, 1893, Dr. Edward Palmer; Pleasant Valley, June 25–30, 1891, G. N. Allen.

Nevada: Pleasant Valley, May, 1865.

Utah: Supply Creek, July 29, 1875, 9000 ft., L. F. Ward; Salt Lake Valley, July, 1888, J. H. Paul; Bear River Cañon, Aug., 1869, S. Watson.

Colorado: Hot Sulphur Springs, Middle Park, Aug. 1, 1881, Geo. Engelmann; Twin Lakes, July 6, 1896, Biltmore Herb.

Montana: West Gallatin River, June 9, 1883, F. Lamson-Scribner, no. 271, "moist banks"; Helena, June, 1888, F. D. Kelsey.

Wyoming: F. Tweedy; Yellowstone National Park, Mrs. Moore, 1894; Mammoth Hot Springs, 6000–7000 ft., June 4, 1894, F. H. Burglehaus; May, 1889, 6600 ft., F. W. Dewart; North Platte, "wet sandy bottom," July 25, 1858; Jackson's Hole on Snake River, June 18, 1860, F. V. Hayden, "gravelly bottoms. 6000 ft.;" Ft. Bridger, July, 1873, T. C. Porter.

A species resembling forms of *S. angustifolium* but evidently distinct, and probably not distantly related to *S. halophilum* but usually much stouter and taller and with much larger flowers. It differs from *S. angustifolium* mainly in much less elongated outer bract and larger interior scales, more narrowly winged stem, constricted below the frequently deflected spathes, larger flowers and apparently smaller fewer-seeded capsules. The material at hand, however, is inconclusive as to the exact character of the mature capsule and seeds.

Certain small specimens, imperfect as to flowers and fruit, appear somewhat intermediate with *S. halophilum*, but the fully developed states of the two plants show them to be distinct. From *S. halophilum* the present species differs in brighter green color, less thickened roots, broader leaves and stem, the latter more decidedly winged, larger spathes with more unequal and acute bracts, larger flowers on more slender pedicels, larger and darker glabrate capsules.

Several small specimens from the Mammoth Hot Springs with mostly curved stems, and leaves very variable in length and breadth are referred here with some hesitation. A single specimen from North Dakota is old and fragmentary but at present can be placed with no other species than this. In fact I am obliged to make this species for the present a repository for a somewhat ill-assorted series of specimens which may represent more than one species but which it is impossible to place satisfactorily wanting a better knowledge of their flowers and mature fruit.

Sisyrinchium segetum sp. nov.

Duller green and less glaucous than *S. occidentale*, even scarcely glaucescent, with narrower and thinner leaves and more numerous and narrower stems apparently growing close together in dense masses rather than tufted: leaves mostly setaceous and 1 mm. wide (.5–1.5 mm.), not very close-nerved except when young, sometimes roughish toward the tapering aculeate often bent apex: stems mostly 1 mm. or less wide, the narrow wings thin, with almost hyaline edges: spathes mostly purplish to red-purple, sometimes nearly green, stiffly erect, the outer bract very slenderly attenuate sometimes for fully half its length, tapering acute, 18–38 mm. long, subequal with the inner bract or surpassing it by 12 mm., or even more, the inner bract narrower, more slenderly attenuate and less hyaline-margined than in *S. occidentale*: flowers on very slender often subspreading pedicels, very large and deep violet-blue, the perianth 12–17 mm. long indicating an extreme spread of over 3 cm., the segments slenderly aristulate; stamineal column 5–7 mm. high; capsules broadly oblong, 5–6 mm. high, brown, transversely corrugate, many-seeded, seeds irregularly obovate, 1 mm. in longer diameter, black, faintly pitted to smooth.

Washington: Seattle, May, 1892, in full flower, Chas. V.

Piper, ex Herb. Young Naturalist's Society, Herb. Columbia University; Yakima region, T. S. Brandegee, 1882, mature fruit, Herb. Mo. Bot. Gard.

Oregon: "Prairies Western Oregon," May, 1880, in full flower, Thomas J. Howell; distributed as *S. bellum* Watson in Howell's "Pacific Coast Plants," U. S. Nat. Herb.

Nevada: Washoe Co., alt. 1500 m., July 21, 1896, mature fruit, F. V. Coville and J. B. Leiberg, U. S. Nat. Herb.

An attractive plant evidently with close affinity to *S. occidentale*; though not actually proved to be distinct by the few specimens before me I feel little hesitation in giving it a name. It appears to be less glaucous than *S. occidentale* with narrower more numerous and crowded leaves and stems of thinner texture, slenderer roots, larger often red-purple spathes and narrower mostly more unequal bracts, the inner one especially more attenuate and acute. The highly colored spathes give the plant much the aspect of forms of *S. mucronatum* of the East.

The sheet of specimens cited from Nevada shows fruiting plants which differ strikingly from the other examples, yet for the present I can refer them nowhere else than here. They are very slender with long somewhat flexuous stems and very narrow deflected spathes having the lower part for about 5 mm. scarcely or not at all broader than the stem.

SISYRINCHIUM HALOPHILUM Greene, Pittonia **4**: 34. 17 Mr. 1899

Very pale dull green and white glaucous, mostly low, 10–20 cm. high, stiff and erect or nearly so, the thickened roots densely clustered: leaves half the height of the stem or longer, stiff and thickish, often slightly curved, 1–3 mm. wide, strongly close-striate, smooth-edged, attenuate, acute, in age developing hard-pointed tips: stem from less than 1 mm. to 2 mm. wide, wiry, ascending or outcurved, margined to narrowly winged, the wings thick and firm, smooth-edged: spathes erect, green, rather flat and sharp-edged, 2–4 mm. wide, the bracts striate, subequal or the outer one slightly prolonged; outer bract 15–22 mm. long, usually somewhat convex, acuminate to a short-pointed mostly obtuse often incurved apex, hyaline-margined, united clasping for 3–4 mm. at base; inner bract more broadly hyaline, abruptly acute to obtuse; interior scales more than half the length of the inner bract: flowers 4–8, small to medium-sized, perianth apparently becoming 10 mm. long, violet-blue; capsules 2–3.5 mm. high, subglobose, often broader than long, strongly trigonous, or even trilobulate around an impressed base, pale, scabrous-puberulent, on erect, slightly exserted pedicels: seeds few, 1–3 in each cell, large, becoming 1.5 mm. long, rugulose-pitted.

Nevada: Humboldt Wells, July 25, 1893, Edw. L. Greene, Herb. E. L. G.; Diamond Valley, July, 1868; 5500 ft. alt., S. Watson, Torrey Herb. and Herb. Mo. Bot. Gard.

California: Bishop, Owen's Valley, alt. 5000 ft., May 15, 1897, M. E. Jones, U. S. Nat. Herb.

Type specimens from Humboldt Wells, Nevada, which have been kindly sent me by Professor Greene are not closely matched by anything else I have seen and may perhaps represent a specialized halophilous type.

Sisyrinchium leptocaulon sp. nov.

Growing in erect narrow tufts from coarse fibrous roots, rather bright pale green and glaucescent, the spathes mostly dull purplish: stems numerous, very slender, 20–38 cm. high: 1 mm. or less wide, wiry and subterete, slightly constricted just below the spathe, the almost membranous margins very narrow or even obsolete: leaves about half the height of the stem or less, equally slender or sometimes the shorter ones becoming 2 mm. wide, smooth-edged, attenuate, the apex often linear with a thickened corneous tip, which is obtuse or acute: spathes very small and narrow, the base less flattened and more narrowed than in *S. halophilum*, the bracts subequal or the outer one rarely surpassing the inner 8 mm.; outer bract 12–22 mm. long, hyaline-margined to the short and rigid, linear, obtuse prolongation, closely united clasping for 2–4 mm. at base; inner bract hyaline-margined to the very obtuse or truncate scarious apex; longer interior scales sometimes nearly equaling the inner bract, longer and narrower than in *S. halophilum*: flowers 3–9, blue or violet, small, the perianth apparently only 7–9 mm. long, the stamineal-column 3–6 mm. high; pedicels 13–22 mm. long, erect and exserted for about one quarter of their length, usually flattened and margined: capsules very small, 1.5–3 mm. high, often distinctly pyriform though sometimes abruptly contracted at both ends, finely scabrous-rugulose and sparsely puberulent, pale but much purplish-tinged, thinner-walled than in *S. halophilum* and less strongly trigonous: seeds few, only 1–3 in each cell, subglobose or broadly oblong, finely rugulose, 1–1.5 mm. in longer diameter.

California: Near Lake Tahoe, July 20, 1889, J. Ball, Herb. Acad. Nat. Sci. Phil.

Nevada: Deeth, July 14, 1896, E. L. Greene; Ruby Valley, July, 1868, 6000 ft., S. Watson, ex Torrey Herb. and Herb. U. S. Nat. Mus.

Utah: Parley's Peak, 6000 ft., June, 1869, S. Watson, ex Torrey Herb.

Nearly allied to *S. halophilum* Greene, and possibly a variety of that species, although I am inclined to regard it as quite distinct. It is a taller, and more slender plant than *S. halophilum*, of a very perceptibly brighter and more yellowish shade of green and with straighter and more clustered stems; these are long and exceedingly slender with the wings reduced to little more than membranous edges. The narrower leaves are less strongly striate and thickened than in *S. halophilum* and more slenderly attenuate, and are apparently also without the abrupt membranous expansion at the extreme base although narrowly clasping below for a longer distance. The purplish spathes are less flattened and less decidedly two-edged below, the narrower bracts less strongly striate, narrower and usually more unequal, the outer one less convex with longer linear tip, the inner one more abruptly scarious-obtuse; the capsules are smaller, more pyriform, thinner-walled, less strongly trigonous and more rugulose and scabrous-puberulent.

Sisyrinchium septentrionale sp. nov.

Growing in small tufts 10–25 cm. high, pale and glaucous, discoloring slightly in drying. Leaves ½–¾ the height of the taller stems, equaling the shorter ones, stiff and erect, mostly setaceously slender and .5–1 mm. wide, rarely 1.5 mm., finely close-striate, attenuate to an acute point: stems equally slender with the leaves, stiff and narrowly firm-margined, the edges like those of the leaves smooth or, when young, minutely denticulate: spathes small, purplish or green, often partly double, one or more flowers arising from between the short proper spathe and the closely subtending slenderly prolonged outer bract; inner bract 13–20 mm. long, mostly attenuate and acute, the outer one 2.5–4 cm. long, and united-clasping for 2–3 mm. at base; both bracts hyaline-margined; interior scales about ¾ the length of the pedicels; flowers very small, apparently not more than 3–4 on erect pedicels usually shorter than the inner bract; perianth 4–7 mm. long, acuminate and short aristulate, not retuse, apparently pale rose or violet; stamineal column about 3 mm. high: capsules on firm erect pedicels about 15 mm. long, pale, subglobose, relatively large, 3–5 mm. high.

Assiniboia: Moose Mountain Creek, June 6, 1883, J. M. Macoun, "margins of marshes and streams," just in flower. Herb. Torr. Bot. Club.

Alberta: Near Banff, July 8, 1891, Macoun, in flower and young fruit. U. S. Nat. Herb. and Herb. Mo. Bot. Gard.

Washington: Wilkes Expedition, 1838–42, "Spokane to Colville." U. S. Nat. Herb.

Idaho: Soda Springs, June 21, 1892, A. Isabel Mulford.

Characterized especially by small size, extremely narrow leaves and stems, very small, pale flowers, with the divisions of the perianth non-emarginate, slenderly much prolonged outer bract and relatively large subglobose capsules. Perhaps most nearly related to *S. alpestre*. The specimens from Idaho are without perfect flowers or fruit; though resembling those from British America they have much less elongated primary bract and may not be the same.

Sisyrinchium alpestre sp. nov.

Tufted, becoming 20 cm. high, dull green and glaucous, discoloring slightly when dry. Leaves about half the height of the stem, stiff and erect, .5–2 mm. wide, closely striate-nerved, rather abruptly cuspidate acute, the edges smooth or slightly denticulate above in young leaves: stems slender, 1–1.5 mm. wide, narrowly firm-winged, the edges smooth, distinctly broadened into the base of the spathe: spathes green, narrow, 2 mm. or more wide at base, the outer bract very long and slender, sometimes slightly broadened above the middle, straight or curved, 4.5–6.5 cm. long, surpassing its fellow 2.5–3.8 cm., the margins narrowly hyaline below, united-clasping for 4–6 mm. at base; inner bract 1.8–3 cm. long, narrow and slenderly prolonged, acute, the margins below white-hyaline; interior scales broad, obtuse, about half the length of the fruiting pedicels: flowers on firm erect pedicels 14–18 mm. long, and shorter than the inner bract, small, perianth apparently only 6–10 mm. long, with the divisions not emarginate but narrowed to a short-aristulate tip, faded but appearing white, though in one flower showing the faintest tinge of violet; column becoming 5 mm. long: immature capsules narrowly obovoid-oblong, evidently large and apparently obovoid at maturity, the oldest one 6 mm. long and 4 mm. wide at the top.

Colorado: Como, 9775 ft. altitude, in meadow, Aug. 3, 1895. "Crandall & Cowen," no. 477, Flora of Colorado. U. S. Nat. Herb.

Related to *S. angustifolium*, and perhaps to be referred to an alpine variety of that species, but *S. angustifolium* is also a plant of very high altitudes in Colorado, occurring in a stout and nearly typical form which contrasts notably with the slender plant here described, although more slender Rocky Mountain forms of *S. angustifolium* appear less distinct. An understanding of the true status of the plant must await further material, especially the mature fruit. In any case it is clearly something quite different from the ordinary eastern *S. angustifolium.* In respect of the slenderly prolonged inner bract and small pale flowers with non-emarginate segments the plant shows much similarity to *S. sarmentosum* and in its flowers and general habit to the much smaller *S. alpestre.* It differs from typical *S. angustifolium* in duller gray-green color, greater slenderness, thicker and more closely striate leaves, narrower and more slenderly prolonged bracts which are less strongly nerved and with more hyaline edges, smaller paler flowers with unnotched segments, shorter pedicels, more obovoid-oblong capsules.

S. SARMENTOSUM Suksdorf; Greene, Erythea **3**: 121. 1895.

Tufted or closely massed in growth, 1.5–2.8 cm. high, dull green and glaucescent discoloring in drying: roots slender and numerous: leaves rather thin, erect, equaling the stem or shorter, rather weakly nerved, 1–3 mm. wide, attenuate, acute, smooth-edged or sometimes serrulate when young: stem 1–1.5 mm. wide. narrowly wing-margined, the wings not broadened into the base of the spathe, smooth-edged or obscurely denticulate, erect or somewhat outcurved, simple and leafless, or occasionally developing a terminal node bearing a slender elongated leaf or cluster of several leaves subtending an outcurved peduncle: spathes green, erect or bent forward, narrow, 1–2 mm. wide at base, the bracts foliaceous, thin and somewhat membranous, striate, closely parallel, both narrowly prolonged to the rather abruptly acute or obtusish apex, the outer one 3–6 cm. long, surpassing the inner one 1–2.5 cm., broadened above the middle, the margins narrowly hyaline, united for 3–5 mm. at base; inner bract more than half the length of the outer one, also herbaceously prolonged but narrower and more scarious margined, 2–3.5 cm. long: flowers 1–3, light blue, small, the perianth 7–10 mm. long, the segments not usually emarginate but abruptly contracted into the short-aristulate tip: stamineal column 4–5 mm. long; pedicels slender, in fruit 1.5–2.5 mm. long, ascending or somewhat spreading from about midway in the spathe: capsules thin-walled, subglobose, transversely corrugate at maturity, 4–5 mm. high: seeds not fully mature, black, finely rugulose pitted, asymetrically obovoid or curved, angled.

Washington, Skamania Co., no. 2233, W. N. Suksdorf, August 31, 1893. "Borders of meadows 2000–3000 ft. altitude." In full flower and fruit.

As remarked by Professor Greene in his publication of this species the fitness of the name given by Suksdorf is not evident. I have examined three sheets of the original collection mounting several good sized tufts as well as separate specimens. The printed label reads "stems sometimes rooting at the nodes," but no evidence of such a character is shown by the specimens, which are simple-stemmed and erect, bearing a node, when at all, only at the top.

The plant is clearly an excellent species. Its very narrow bracts alone, especially the narrowly foliaceous inner one, give it an aspect quite different from that of any other species known to me except perhaps *S. alpestre*, which is amply different in other respects. In the nearest approach to this character of the inner bract ever seen in *S. angustifolium* the herbaceous prolongation is more or less abruptly attenuate, quite in contrast with the linear-prolonged and more foliaceous condition characteristic of *S. sarmentosum*. An approach to this condition, but on a larger scale, is sometimes seen in *S. Idahoense* and *S. littorale*. *S. sarmentosum* differs further from *S. angustifolium* in slender, often curved stems with the wings not widened into the base of the spathe, which is frequently deflected and much narrower, fewer smaller flowers on more slender and spreading pedicels, the segments of the perianth not emarginate, smaller fruit.

SISYRINCHIUM LITTORALE Greene, Pittonia, **4**: 33. 17 Mr. 1899.

Apparently little or not at all tufted, stout, 15–35 cm. or more tall, or sometimes much lower and depauperate, apparently not glaucous, or but slightly so, dull green, turning dark in drying: roots fibrous, slender, mostly spreading from a strong woody axis: leaves 2–4 mm. wide, half the height of the stem or longer, erect, rather thin and openly striate-nerved, tapering-acute or acuminate, narrowed to both base and apex, the edges mostly roughened, the inner margins below white-scarious; stems stout, simple, rarely bearing a terminal leaf subtending an erect peduncle, 2–3 mm. wide, prominently winged, the wings with thin serrulate edges, not broadened into the base of the spathe and showing a slight transverse constriction at the top: spathes green, erect, or slightly deflected, 4–6 mm. wide, flat, the bracts foliaceous; primary bract 3.7–8 cm. long, surpassing the inner bract mostly 1–4 cm., only exceptionally twice its length, very gradually narrowed to the acute or obtuse pointed apex, the inner margins below narrowly white-hyaline, united for about 5 mm. at the base; inner bract 2.3–4.8 cm. long, often of nearly equal breadth throughout below the abruptly somewhat obtuse apex, or occasionally narrowly prolonged; interior scales narrow, much shorter than the inner bract: flowers few, 1–4, on pedicels mostly a little shorter than the inner bract, large, deep violet-blue with an orange-yellow eye, the perianth 12–14 mm. long; anthers relatively small; stamineal column about 6 mm. high: capsules large and thick-walled, dark, obovoid or subglobose, 6–8 mm. high, on erect or slightly spreading pedicels 1–2 cm. long: seeds globose, 1.5 mm. in diameter, black, rugulose-pitted almost to maturity when nearly smooth, the umbilicus usually appearing as a mere cleft.

Grassy beaches and shores, coast of Alaska, beginning to flower in late June and early July, fruit ripe in August. So far as known, restricted to the southern Alaskan coast and the only species of *Sisyrinchium* occurring in that territory. Shores of Yes Bay, July 3, 1895, Thos. Howell, no. 1662; Back Bay, July 3, 1895, M. W. Gorman; shores of Behm canal, Aug. 3, 1894, M. W. Gorman; Sitcha, Ferd. Bischoff, 1865–7, Dr. Tiling, 1867.

Although long known and of late years fairly well distributed in collections, this Alaskan plant seems never to have been looked upon as different from the eastern *S. angustifolium* until recently distinguished by Professor Greene, as a matter of fact since the above description was penned. In other writings, as on specimen labels, the plant has been variously referred to as *S. angustifolium* under the names *S. anceps* Cav., *S. Bermudiana* var. *anceps* Gray and *S. mucronatum* Michx. The species is well distinguished from *S. angustifolium* being larger in every way, in fact, notwithstanding its boreal habitat the stoutest species of the simple-stemmed section of the genus. It is not nearly so pale and glaucous as *S. angustifolium*, if at all so, and dries much darker; the leaves and stem are broader, the spathes and bracts larger and of a somewhat different shape, the flowers and especially the fruit larger, the seeds little larger but darker, more globose and more distinctly and narrowly umbilicate. *S. littorale* has perhaps its nearest relative in *S. Idahoense*, but is clearly separable by thinner and broader leaves and stem, smaller flowers and larger fruit.

Index to recent Literature relating to American Botany.

Anderson, A. P. A new *Tilletia* parasitic on *Oryza sativa* L. Bot. Gaz. **27**: 467–472. *f. 1–4.* 22 Je. 1899.

Atkinson, G. F. Studies and Illustrations of Mushrooms: II. Bull. Cornell Univ. Agric. Exper. Sta. 168: 491–516, *f. 83–97.* My. 1899.

Bower, F. O. Studies in the morphology of spore-producing members: IV. Leptosporangiate Ferns. Ann. Bot. **13**: 320–324. Je. 1899.

Brandegee, T. S. New Species of western Plants. Bot. Gaz. **27**: 444–457. 22 Je. 1899.

Bunting, M. The Structure of the Cork Tissues in Roots of some Rosaceous Genera. Contr. Bot. Lab. Univ. Penn. **2**: 54–65. *pl. 10.* 1899.

Celakovsky, L. J. Das Prioritätsgesetz in der botanischen Nomenclatur. Bot. Centralb. **78**: 225–234. 10 My. 1899; 258–268. 17 My. 1899.

C[lute], W. N. How to identify the Shield Ferns. Fern Bull. **7**: 59–63. Jl. 1899.

Cowles, H. C. The Ecological Relations of the Vegetation of the Sand Dunes of Lake Michigan. Bot. Gaz. **27**: 361–391. *f. 19–26.* 20 My. 1899.

Daniel, L. La variation dans la greffe et l'hérédité des charactères acquis. Ann. Sc. Nat. VIII. **8**: 1–192. *f. 15.* 1899.

Darbishire, O. V. On *Actinococcus* and *Phyllophora.* Ann. Bot. **13**: 253–267. *f. 1–7. pl. 15.* Je. 1899.

Dixon, H. H. The possible Function of the Nucleus in Heredity. Ann. Bot. **13**: 269–278. Je. 1899.

Durand, E. J. A Washing Apparatus. Bot. Gaz. **27**: 394–395. *fig.* 20 My. 1899.

Eaton, A. A. The Genus *Equisetum* with reference to the North American Species. Fern. Bull. **7**: 57–59. Jl. 1899.

Evans, W. H. An undescribed birch from Alaska. Bot. Gaz. **27**: 481–482. 22 Je. 1899.

Fernald, M. L. & Sornborger, J. D. Some recent Additions to the Labrador Flora. Ottawa Nat. **13**: 89–107. Jl. 1899.

Guignard, L. Sur les autherozoides et la double Copulation sexuelle chez les végétaux angiospermes. Rev. Gen. de Bot. **11**: 129–135. *pl. 4.* 15 Ap. 1899.

Harper, R. M. The Pteridophytes of Georgia. Fern Bull. 7 : 65–67. Jl. 1899.

Harshberger, J. W. Statistical Information concerning the Production of Fruit and Seeds in Certain Plants. Contr. Bot. Lab. Univ. Penn. **2**: 100–109. 1899.

Harshberger, J. W. Water Storage and Conduction in *Senecio praecox* DC. from Mexico. Contr. Bot. Lab. Univ. Penn. **2**: 31–40. *pl. 7, 8.* 1899.

Holm, T. *Podophyllum peltatum.* Bot. Gaz. **27**: 419–433. *f. 1–10.* 22 Je. 1899.

Houlbert, Ch. Phylogenie des *Ulmacées.* Rev. Gen. de Bot. **11**: 106–119. *pl. 2, 3.* 15 Mr. 1899.

Kennedy, P. B. The Structure of the Caryopsis of Grasses with Reference to their Morphology and Classification. Bull. U. S. Depart. Agric. (Div. Agrost.) 19 : 1–44. *pl. 1–8.* 1899.

Kuntze, O. La nomenclature réformie des Algae et Fungi, d'apres le Code parisien de 1867 et contre les fantaisies de M. Le Jolis. Jour. de Bot. **12**: 17–26. Ja. 1899.

Knoch, Ed. Untersuchungen über die Morphologie, Biologie und Physiologie der Blüte von *Victoria regia.* Bibliotheca Botanica, 47 : 1–57. *pl. 1–6.* 1899.

Lang, W. H. The prothallus of *Lycopodium clavatum.* Ann. Bot. **13**: 279–317. *pl. 16, 17.* Je. 1899.

Lovell, J. H. The Insect Visitors of *Iris versicolor.* Asa Gray Bull. 7 : 47–50. Je. 1899.

Macfarlane, J. M. Observations on some Hybrids between *Drosera filiformis* and *D. intermedia.* Contr. Bot. Lab. Univ. Penn. **2**: 87–99. *pl. 12.* 1899.

Maxon, W. R. A Variety of *Dicksonia.* Fern Bull. 7 : 63, 64. Jl. 1899.

McKenney, R. E. B. Observations on the Development of some Embryo-sacs. Contr. Bot. Lab. Univ. Penn. **2**: 80–86. *pl. 11.* 1899.

Meehan, T. *Calluna vulgaris.* Meehan's Month. **9**: 65–66. *pl. 5.* My. 1899.

Meehan, T. *Echinocactus Whipplei.* Meehan's Month. 33–34. *pl. 3.* Mr. 1899.

Meehan, T. *Solidago nemoralis.* Meehan's Month. 49–50. *pl. 4.* Ap. 1899.

Mohr, C. Alvin Wentworth Chapman. Bot. Gaz. **27**: 473–478. Portrait. 22 Je. 1899.

Palla, E. Ueber die Gattung *Phyllactinia.* Ber. Deutsch. Bot. Gesell. **17**: 64–72. *pl. 5.* 23 Mr. 1899.

Palladine, W. Influence de la lumière sur la formation des matieres proteiques actives et sur l'energie de la respiration des parties vertes des végétaux. Rev. Gen. de Bot. **11**: 81–105. 15 Mr. 1899.

Pee-Laby, E. Étude anatomique de la feuille des Graminées de la France. Ann. Sc. Nat. VIII. **8**: 227–346. *f. 1–18. pl. 11–13.* 1899.

Pittier, H. Primitiae Florae Costaricensis. Gamopetalae. (By J. Donnell Smith.) Inst. Fis. Geog. Nac. Costa Rica, 1899.

Pollard, C. L. The Ostrich Fern in Virginia. Fern Bull. **7**: 71. Jl. 1899.

Purpus, C. A. Eine Succulententour in das Wüstengebiet des südlichen Nevada, des nordwestlichen Arizona und des südwestlichen Utah. Monatssch. für Kakteenkunde, **9**: 49–52. 15 Ap. 1899; 65–68. 15 My. 1899.

Reinke, J. & Braunmüller. Untersuchungen über den Einfluss des Lichtes auf den Gehalt grüner Blätter an Aldehyd. Ber. Deutsch. Bot. Gesell. **17**: 7–12. 20 F. 1899.

Sauvageau, C. Les *Acinetospora* et la Sexualité des Tilopteridacées Jour. de Bot. **13**: 107–127. Ap. 1899.

Schaffner, J. H. Origin of Timber Belts. Bot. Gaz. **27**: 392–393. 20 My. 1899.

Schaffner, J H. The Spreading of Buffalo Grass. Bot. Gaz. **27**: 393–394. 20 My. 1899.

Schively, A. F. Recent Observations on *Amphicarpaea monoica.* Contr. Bot. Lab. Univ. Penn. **2**: 20–30. 1899.

Schneck, J. *Phacelia Covillei* at Mt. Carmel, Ill. Bot. Gaz. **27**: 395–396. 20 My. 1899.

Schumann, K. *Echinocactus Grahlianus* F. Hge. jun. und seine Verwandten. Monatssch. für Kakteenkunde, **9**: 54–55. 15 Ap. 1899. [Illust.]

Scribner, F. L. American Grasses, II. Bull. U. S. Depart. Agric. **17**: 1–349. *f. 303–627.* 1899.
Includes some new species and new names.

Sherman, P. L. & Briggs, C. H. Saw Palmetto. Pharm. Archives, **2**: 101–116. Je. 1899.

Analyses of the fruit.

Simons, E. A. Comparative Studies on the Rate of Circumnutation of some flowering Plants. Contr. Bot. Lab. Univ. Penn. **2**: 66–79. 1899.

Smith, J. G. Studies on American Grasses. A Synopsis of the Genus *Sitanion*. Bull. U. S. Depart. Agric. (Div. Agrost.) 18: 1–21. *pl. 1–4.* 24 Je. 1899.

S. jubatum, *S. villosum*, *S. multisetum*, *S. breviaristatum*, *S. minus*, *S. rigidum*, *S. Californicum*, *S. glabrum*, *S. insulare*, *S. cinereum*, *S. caespitosum*, *S. montanum*, *S. strigosum*, *S. molle*, *S. brevifolium*, *S. longifolium*, *S. pubiflorum*, *S. planifolium*, *S. lanceolatum*, and *S. anomalum*, new species.

Smith, J. D. Undescribed Plants from Guatemala and other Central American Republics, XXI. Bot. Gaz. **27**: 331–339. 20 My. 1899; 434–443. 22 Je. 1899.

Snow, J. W. *Pseudo-Pleurococcus* nov. gen. Ann. Bot. **13**: 189–195. *pl. 11.* Je. 1899.

Spegazzini, C. Nova Addenda ad Floram Patagonicam. Anales Soc. Cien. Argentina, **47**: 224–239. My. 1899.

Includes several new species.

Thompson, C. B. The Structure and Development of Internal Phloem in *Gelsemium sempervirens* Ait. Contr. Bot. Lab. Univ. Penn. **2**: 41–53. *pl. 9.* 1899.

Townsend, C. O. The effect of ether upon the germination of spores. Bot. Gaz. **27**: 458–466. 22 Je. 1899.

Ule, E. Ueber spontan entstandene Bastarde von Bromeliaceen. Ber. Deutsch. Bot. Gesell. **17**: 51–64. *pl. 4.* 23 Mr. 1899.

Ule, E. Ueber einige neue und interessante Bromeliaceen. Ber. Deutsch. Bot. Gesell. **17**: 1–6. 20 F. 1899.

Ule, E. Ueber eine experimentell erzeugten Aristolochien-bastard. Ber. Deutsch. Bot. Gesell. 35–40. *pl. 3.* 20 F. 1899.

Van Tieghem, Ph. Spores, Diodes et Tomies. Jour. de Bot. **13**: 127–132. Ap. 1899.

Vries, H. de. Sur la Culture des Fasciations des Espèces annuelles et bisannuelles. Rev. Gen. de Bot. **11**: 136–151. 15 Ap. 1899.

Vries, H. de. Ueber die Periodicität der partiellen Variationen. Ber. Deutsch. Bot. Gesell. **17**: 45–51. 23 Mr. 1899.

Ward, H. M. Thames Bacteria. Ann. Bot. **13**: 197–251. *pl. 12–14.* Je. 1899.

Waugh, F. A. A Conspectus of the genus *Lilium*. Bot. Gaz. **27**: 340–360. *f. 1–14*. 20 My. 1899.

Waugh, F. A. What is *Prunus insititia*? Bot. Gaz. **27**: 478–481. 22 Je. 1899.

Westermeier, N. Züchtungs-Versuche mit Winterroggen. Bot. Centralb. **78**: 33–38. 29 Mr.; 65–70. 5 Ap.; 97–104. 12 Ap. 1899.

Williams, T. A. Half hours with Lichens, III. Asa Gray Bull. **7**: 52–55. Je. 1899.

Williams, E. M. The broad-gilled *Collybia*. Asa Gray Bull. **7**: 39, 40. *pl. 4*. Je. 1899.

Wilson, L. L. W. Observations on *Conopholis Americana*. Contr. Bot. Lab. Univ. Penn. **2**: 3–19. *pl. 1–6*. 1899.

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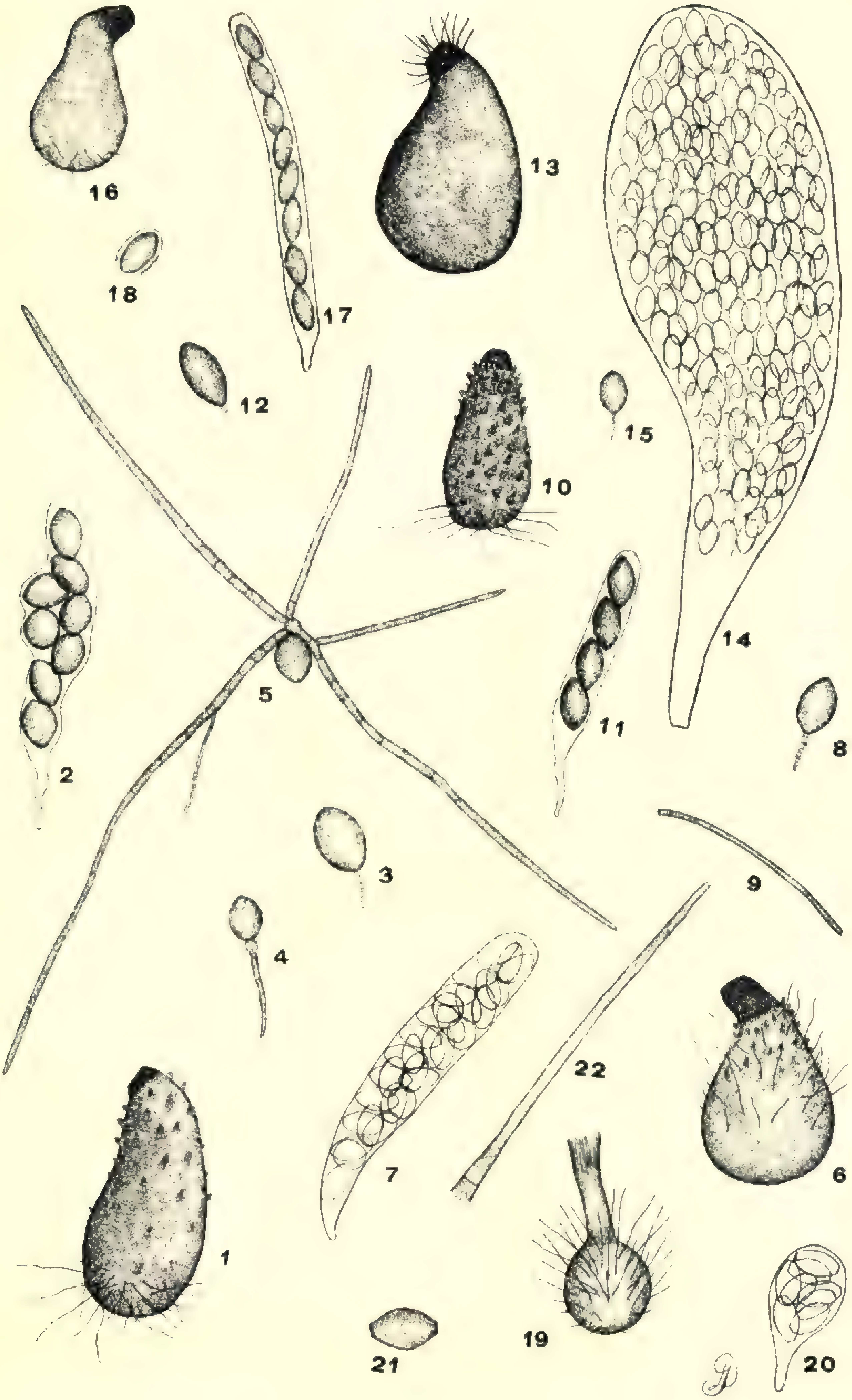
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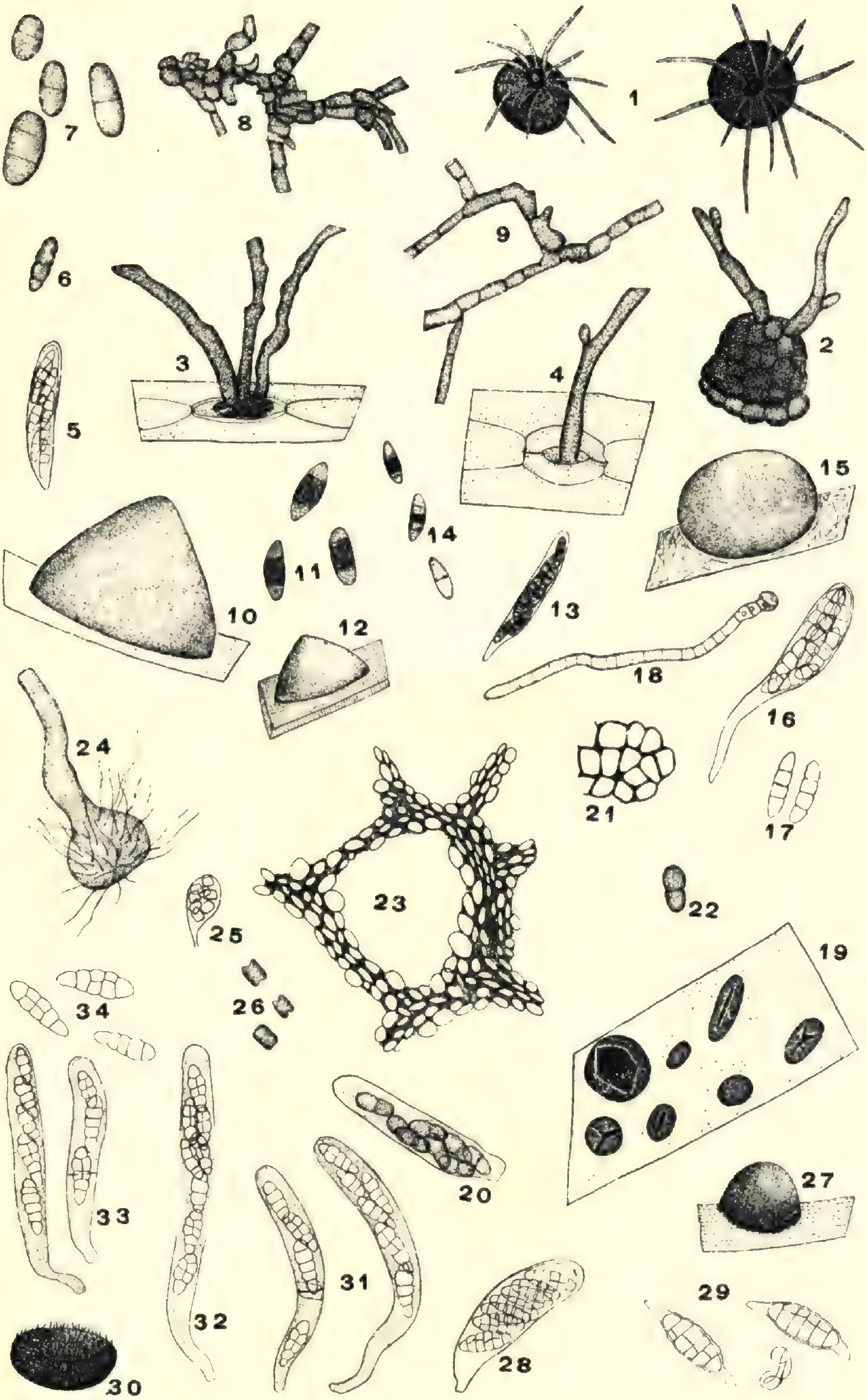
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VOL. 26 No. 9

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TORREY BOTANICAL CLUB

SEPTEMBER 1899

The Effect of Chemical Irritation on the Economic Coefficient of Sugar

HERBERT MAULE RICHARDS

It has been known since Raulin's* account of the nutrition of fungi that certain metallic salts—notably those of zinc—induce a more rapid growth of fungi than is normal, although, as has been shown by more recent work,† he somewhat misinterpreted the action of these salts. It is now well known, as has been demonstrated by many competent experimenters, that a much simpler nutrient solution than was thought necessary in Raulin's time is adequate for an entirely normal development of fungi. With some available source of carbon and nitrogen it is only necessary to add salts containing potassium, magnesium, sulphur, phosphorus, and a trace of iron to provide a suitable substratum for the growth of these saprophytic hyphomycetous fungi which have been experimented with.‡ The action of the metallic salts noted by Raulin, as well as of others not considered by him, is to be regarded as a response to a chemical irritation which in some way hastens the metabolic activity of the fungus. The result is the production within a given time of a greater amount of dry substance as compared with the same fungus grown under similar conditions, but on solutions free from the irritant. For further particulars as to the range of substances which affect this abnormal growth and

---

* Études Chimique sur la Vegetation, Ann. d. Sc. Nat. Bot. V. **11** : 91. 1869.

† Die Beeinflussung des Wachsthums einiger Pilze durch chemische Reize. Richards, Prings. Jahrb. **30** : 665. 1897.

‡ Pfeffer, Pflanzenphysiologie, **1** : 374.

[Issued September 22.]

the comparative violence of the irritation, reference is made to the paper already cited.* It will be seen that numerous metallic salts and some organic substances were found which more or less markedly bring about the above noted effect and that their action is constant, although the organic substratum, or the nitrogen source, be changed. Iron salts have a double effect, acting in the first place as a necessary substance for the growth of fungi,† and in the second place in stronger solutions having a distinctly irritating effect.

It was the object of the following recorded experiments to endeavor to throw some light on the physiological action of this chemical irritation, to approach a little nearer to discovering the underlying cause of the abnormal growth of these fungi under such conditions. As a first step in this direction cultures and analyses were made to determine if there was any regular and considerable variation in the economic coefficient of the organic food material supplied to the fungus.

Because of its greater ease in determination sugar was employed as the organic basis of the nutrient solution and many analyses were made to determine what relation the weight of dry substance produced for the amount of sugar used bore between the normal culture, and those growing under chemical irritation. It would, no doubt, have been interesting for further comparison to have used other organic substrata, such as glycerin, but it was hardly necessary in this instance to do so in order to prove the point desired, and the difficulty of accurate quantitative determination of glycerin made it impracticable with the facilities at hand for such research.

For the cultures the usual method of growing the fungi in flasks was employed. For most of the experiments the ordinary Florence flasks of about 125 cc. capacity were used; they were selected with due care as regards similarity of shape, and any error due to difference in area of the surface of the culture fluid could not have been considerable. In these flasks 50 cc. of the nutrient solution was used; for larger quantities, where 100 cc. was taken, Erbenmeyer flasks of Jena glass, about 250 cc. in capacity, were selected. The sowings of the fungus spores were not made by the addition of water in which the spores hung suspended, since it was desired not to weaken the solutions and thereby involve another chance of error in the subsequent analyses. Instead of this method, small pieces of heavy glass rod (about 8 mm. diam.) were taken, their ends slightly moistened and then rubbed on the dry stock culture of the desired fungus. The bits of glass rod, with the attached spores, were then dropped in the prepared flasks; a slight shaking served to dislodge the spores which promptly rose to the surface and with sufficiently even distribution to insure an even growth of the fungus when they germinated. In this way the cultures were provided with at least an approximately equal number of spores, certainly above the maximum required to produce an unbroken carpet of mycelium, and that, as has already been shown, is sufficient to make an equal growth on surfaces of the same area.

---

* Richards, *l. c.*

† Molisch, Pflanze in ihren Beziehungen zum Eisen. Jena, 1892. Benecke, Die zur Ernährung der Schimmelpilze nothwendige Metalle. Prings. Jahrb. **27**: 487. 1895.

As in the previous investigations the greatest care was taken to have all of the substances used for the culture fluids of the greatest practicable degree of purity. The chemically pure salts prepared by Merck & Co. were used and again recrystallized. The sugar was of the best quality obtainable in the market and showed on many tests to be free from impurities. The water was twice distilled, once over a tin-lined still and the second time over glass with alkaline permanganate. It should be added that due care was taken that none of the permanganate passed over. By all tests employed as well as by the evidence of the experiments themselves, the water was shown to be pure. For the irritant substances, the zinc sulphate and lithium carbonate, from which the chloride was prepared, were kindly given the writer by Professor T. W. Richards, of Harvard University. Of the other salts the nickel sulphate and the ferric chloride were the purest obtainable and further purified by successive recrystallizations.

Only one nutrient solution was used—that recommended by Pfeffer * which is identical with solution *A* of the writer's previous paper.† The formula is as follows:

---

* Election organischer Nährstoffe. Prings. Jahrb. **27**: 238. 1895. Pflanzenphysiologie, **1**: 375.

† Richards, *l. c.* p. 667.

NH_4NO_3	1.00
KH_2PO_4	.50
$MgSO_4$	.25
Sugar	5.00
Water	100.00
Trace of iron	

The fungi experimented with were *Sterigmatocystis* (*Aspergillus*) *nigra*, *Penicillium glaucum* and *Trichothecium roseum*.

In making up the solutions it was found most convenient as well as most accurate to prepare them in considerable quantities with all the ingredients except the sugar and of exactly twice the strength desired. Of the solutions thus prepared and with their respective amounts of the irritant substances added, 25 or 50 cc. were taken and exactly the same amount of an accurately prepared 10% sugar solution added. In all of the processes the same pipettes were used throughout and were handled in the same manner, great care being taken of course not to contaminate one solution with another, particularly the control solutions. In this manner it was found practicable to prepare quickly solutions containing a standard of 5% sugar with all the accuracy needed for this work. Numerous test analyses were made of solutions made up after this manner and it was found that they did not vary more than 0.005 grm. in sugar content. It is obvious that it was needful to have confidence in the accuracy of the solutions for upon this point depended the entire result of the work.

When the crop of fungus was harvested the flasks were well shaken and the contents filtered. To the filtrate 1 cc. of a 5% solution of HCl was added and time being allowed for the inversion of the sugar the HCl was then neutralized with Na_2CO_3 and a sufficient amount of water added to dilute the solution to just twice its original bulk, thus weakening it sufficiently to allow of an accurate analysis. From these solutions always two and sometimes more analyses were made. The control cultures were usually two in number; the average between them being the figures printed in the tables. The determination of the sugar was made by the Fehling method. For this purpose the usual solutions of $CuSO_4$ and of alkaline Rochelle salts were made up and mixed freshly for each set of analyses. The Fehling solution was tested against a standard sugar solution each time. The factor (Allen's Industrial Chemistry, vol. I., p. 226) of 10 cc. Fehling solution = 0.0475 cane sugar after inversion was used as the basis of all calculations.

The dry weight of fungus was determined in the usual way, the crop having been collected on a weighed filter was dried in an oven at the temperature of about 70° C. to constant weight.

In the absence of thermostat the cultures were grown at the ordinary room temperature in the laboratory or at a somewhat higher temperature in a room which served also as a conservatory. The cultures were consequently subjected to some fluctuation of temperature, possibly somewhat to the disadvantage of the results obtained. It would, undoubtedly, have been preferable to have grown the *Sterigmatocystis* cultures at a point nearer the optimum for that fungus between 30° and 34° C. In the case of the *Penicillium* the room temperature approximated more nearly the lower optimum of that fungus. In spite of the variations, however, the results for both correspond satisfactorily, the *Sterigmatocystis* cultures being allowed to grow for a somewhat longer period than would otherwise have been necessary.

It would, indeed, have been well to have determined the respiration quotient in relation both to the increased growth and the economic coefficient but the writer was unable at the time to do so, although, it is his intention to experiment in this line in the future. The facts demonstrated, however, show much as to the economic coefficient of the sugar in relation to the abnormal growth caused by chemical irritation despite the fact that at present they cannot be compared with the CO_2 coefficient.

It will be seen by comparison with the results of Kunstmann* that the averages of the economic coefficient obtained from the control cultures is correct. This average approximates 2.00 for the ratio between the amount of sugar used for the dry weight of fungus produced or, as may better be expressed, 0.50 grm. of dry substance for each gram of sugar consumed. In table I. of Kunstmann's paper the average coefficient for those cultures grown between the temperatures of 17° and 25°C. is 2.05 = 0.49. This serves as a check for the results recorded herein.

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* Ueber das Verhältniss zwischen Pilzernte u. verbrauchter Nährung. Inaug. Dissert., Leipzig, 1895.

Taking the control cultures as a base from which comparison can be made, those cultures to which an irritant substance was added now demanded attention. From the results previously obtained such degrees of concentration as showed a marked irritant were employed, the stronger solutions where in the case of the poisonous salts a secondary toxic effect was noted, were not employed, except in one series. With this last named exception all of the ZnSO4 series comprised the following percentages of the anhydrous salt 0.002 %; 0.004 %; 0.008 %; 0.032 %; the last named concentration being just within the range of the toxic effect. In those cultures to which iron salts were added, a much greater degree of concentration is indicated, for it will be remembered that iron has a double effect, first as a necessary food substance for the fungus, and secondarily, when present in larger quantities as an irritant. Consequently the percentages of Fe_2Cl_6 were 0.05 %; 0.10 %; 0.20 %. In the same way the lithium salt, in this case lithium chloride, although not an indispensable ash constituent is not effective as an irritant, except in comparatively strong solutions, and apparently does not exert any poisonous influence on these hyphomycetous fungi. It was used in the following concentrations of 0.125 %; 0.350 %; 0.375 %. In the few series with nickel salts the sulphate was not used in concentrations very much greater than with the ZnSO4, for like the latter salt it is ultimately a poison. The citations above given are in fractions of a per cent., for the sake of comparison with the writer's previous paper which has already been referred to, but it will be observed that in the tables the equivalents of the solutions are given in fractions of the *normal* solution. This method of reckoning in gram-atoms of the irritant or toxic base was employed by Kahlenberg and True* and affords a much better standard for comparison for future works in this line than expressions in terms of per cent. Since in every salt used in these experiments herein described the acid may be regarded as entirely neutral in its effect on the growth of the fungi the whole of the irritant effect is to be referred to the base of the particular salt employed.

Upon examination of the tables it will be seen that the curve of the economic coefficient of the sugar rises with the increase in the dry weight of the fungus, but more abruptly. For instance, in the case of the cultures with $ZnSO_4$ as in the case of irritation it attains its maximum of 0.58 (see general averages, Table V.) at a concentration of 0.004% of this salt, at which point also the maximum weight is shown. In solutions of greater strength the coefficient falls off but more rapidly than does the abnormal growth. At a concentration of 0.032% when the toxic effect of the $ZnSO_4$ begins to be noticeable the economic coefficient has fallen almost to that of the control as also has the weight of dry substance. In yet stronger solutions in which the growth is much retarded the amount of sugar used remains, however, in about this same relation. The cultures in which Fe_2Cl_6 was used do not show the same regularity. Up to the strength of 0.1% the rise of the economic coefficient of the sugar from 0.46 to 0.56 keeps pace with the increase of weight from about 330 mg. to 800 mg. and agrees with the results found with the $ZnSO_4$, but beyond that at a concentration of 0.2% the average of the economic coefficients falls somewhat while the average weight of the fungus crop increases. This was more apparent in the *Penicillium* cultures than in those with *Sterigmatocystis.* In the latter both the weight and ratio remain about equal, while in the *Penicillium* only one series shows any increase (XVIII.) and series XX. indicates a distinct falling off of the coefficient although a considerable gain in weight is shown in the 0.2% culture over that with but 0.1% of Fe_2Cl_6. It is to be observed, however, that in this case the ratio of 0.82 given for the 0.1% culture stands alone in being the highest found in any series. It is this series that has so materially affected the averages, but since no legitimate reason could be discovered for throwing it out it was necessarily included with the rest. In the series with LiCl the two with *Sterigmatocystis* show the same peculiarity, for in the stronger concentration of 0.375% there is a distinct gain in weight with some falling off in the availability of the sugar consumed (series XXII., XXIII.). In the *Penicillium* cultures the ratio rises even in the strongest solution employed but at 0.375% the gain does not correspond to the increase in weight over the 0.25% concentration. In the *Trichothecium* series there is no marked change. All of the series with LiCl agree, however, in showing in the weaker solutions of 0.125% and 0.25% an increase of the ratio over that found in the control cultures corresponding to that found in other experiments. A few series were tried with a nickel salt, the results falling in line with those obtained with the $ZnSO_4$ cultures, the curve of the economic coefficient of the sugar following a course similar to that of the gain in weight.

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* Bot. Gaz. **22**: 81–124. 1896.

In order to compare the abnormal growth caused by these inorganic salts with that produced by organic substances a couple of series were carried through with cocaine as an irritant. As is shown in the previous paper these fungi do not respond very violently to the organic substances therein mentioned and cocaine was selected as being the most potent. The results were surprisingly definite; as will be seen a distinct increase of weight resulted with also an appreciable gain in the ratio amounting to about 0.04.

It will be seen that, although the effectiveness of sugar as a source of organic nutrition increases in general with the increase of growth induced by the irritant substance and diminishes as the latter diminishes, the economic coefficient does not exactly parallel in its curve the gain of dry substance. For instance, supposing that the dry weight of a control culture be 1 and the economic coefficient of the sugar be 0.50, although the dry weight of a culture under similar conditions but with the addition of an irritant be 2 the economic coefficient is not 1.00 but much lower on the average, say 0.60. Indeed, it is not to be expected that the economic coefficient should vary in the same proportion as the increase of weight. Such an example as given above—the ratio of weights is often higher as much as 1 to 3—would require that *all* of the sugar used be available for the production of the fungus mycelium, an impossibility in any event since such a condition would preclude the respiration of any CO_2. Nor is it necessary that the available portion of the sugar used increase in a similar proportion to the dry substance, for it will be remembered that the effect of the irritant substance must, as long as the food supply is not greatly exhausted, be cumulative. Even a smaller increase of the economic coefficient of the sugar than that absolutely found would serve to account for a considerable increase in weight. It is evident from the experiments that of the sugar used more is actually available for the fungus and that provides for and implies a more rapid growth of the latter. Granting this together with the accompanying necessity that the irritant substance is acting continually, it is easy to understand that any gain in weight might be indefinitely multiplied as long as the food supply was sufficient. Since, up to a certain point, the economic coefficient of the sugar rises with the increase of dry weight shows that there must be some relation between the two, that the latter phenomenon must in some measure at least be dependent upon the former. The actual gain in the economic coefficient must at any one time be very small and it is highly probable that given time any two cultures, the one with and the other without an irritant substance added would tend to become equalized.

As the weight of the crop falls with the increase of $ZnSO_2$ so also does the economic coefficient diminish, but the writer would not be prepared to maintain that the toxic effect of this substance is in itself merely the diminishing of the economic coefficient to a vanishing point. It is not to be supposed that the irritant salt acts directly on the sugar but on the fungus in which no doubt other and more subtle changes in the protoplasm are brought about. As was shown indeed in one series even in very much stronger solutions of $ZnSO_4$ where the growth is materially diminished by the salt, the economic coefficient remains practically the same as in the normal. A further discussion of the *toxic* action of this salt is, however, not within the limits of this paper.

While it would be manifestly improper with evidence afforded by only a comparatively few series of experiments from but a single point of view to theorize too widely as to the nature of this chemical irritation, the writer feels justified in arriving at the conclusion that the increase in the availability of the sugar consumed is at least one factor and an important one in determining the increase of growth. In just what way the irritant influences the metabolic activity of the fungus hyphae must be at present at least merely a matter of speculation. The irritant substance is not in itself a source from which energy is available.

In their action as poisons the salts of zinc, nickel, manganese and lithium would come under the third group of poisons as recognized by Loew in his "Naturliche System der Gift Wirkungen,"* which includes those bases that by their power of forming salts with the protein substances of the protoplasm induce disturbances which ultimately end in death. It may be that such indeed is the case, but the poisonous substances so formed being in such minute quantities, owing to the dilute solutions used, do not serve to kill the protoplasm, but merely stimulate its molecular activity in an endeavor to throw off the irritant substance, or to induce what might be called a secondary katalytic action. The results with the salts of iron which are not poisonous do not, however, uphold such a view, yet it is not impossible that in stronger solutions the apparently inocuous base, iron, might prove to exert a poisonous influence. This might be impossible to demonstrate, since the necessary concentration to produce any deleterious effect would be so great as to confuse the results with the osmotic action of the solution. If it is not possible to admit any such semi-toxic action on the part of the irritant substances, it is necessary to fall back upon the idea of their action being strictly katalytic, as suggested by Pfeffer,* or simply to include the phenomenon under the comprehensive phrase "physiological counter-reaction."

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* Munich, 1893. See also Davenport, Experimental Morphology, 1 : 12.

The results of these experiments may be briefly stated as follows:

That the direct action of irritant substances (in this case inorganic salts), which produce an increased growth of certain fungi is to enable the latter to dispose more economically of the sugar used (*i. e.*, to raise the economic coefficient of the sugar) thereby permitting a more rapid production of dry substance in a given time.

That the increase of the economic coefficient is not in proportion to the percentage increase in weight.

That the economic coefficient again decreases when in poisonous substances the maximum of growth is passed, but that it apparently does not ever fall much below the normal.

This work was begun in the Cryptogamic Laboratory of Harvard University in 1897–98 and completed at Barnard College, New York, in 1898–99. The writer would here express his thanks to Professor H. B. Hill, Director of the Chemical Laboratory of Harvard University, for his courtesy in allowing the use of the facilities of that laboratory.

NEW YORK, May, 1899.

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* Pfeffer, Prings. Jahrb. **28**: 238. 1895.

TABLE I.

In all of the cultures a standard of 5% sugar was used. The series are indicated in Roman numerals.

I. *Sterigmatocystis nigra.* $ZnSO_4$ added. Grown at room temp. about 20°C. Harvested one week after sowing.

% $ZnSO_4$. Fraction normal $ZnSO_4$.	Control.	.002% .000125	.004% .00025	.008% .0005	.032% .002
I.					
Weight crop mg.	535	846	1020	945	
Sugar used mg.	930	1220	1400	1315	
Sugar residue mg.	1570	1280	1100	1185	
Econ. Fungus : sugar.	1.74	1.44	1.37	1.39	
Coeff. Sugar : fungus.	0.57	0.69	0.73	0.72	
II as in I.					
Temp. about 20°C. 7 days.					
Weight crop mg.	640	912	1104	842	800
Sugar residue mg.	1845	1315	1300	1370	1305
Sugar used mg.	955	1185	1200	1130	1195
Econ. Fungus : sugar.	1.49	1.29	1.09	1.34	1.50
Coeff. Sugar : fungus.	0.67	0.77	0.92	0.75	0.67
III as in I.					
Temp. about 20°C. 6 days.					
Weight crop mg.	330	535	817	800	400
Sugar residue mg.	1825	1605	1320	1284	——
Sugar used mg.	675	895	1180	1216	——
Econ. Fungus : sugar.	2.00	1.67	1.44	1.52	——
Coeff. Sugar : fungus.	0.49	0.59	0.69	0.66	——
IV as in I.					
Temp. circa 24°C. 8 days.					
Weight crop mg.	510	830	943	912	615
Sugar residue mg.	1306	1164	1029	1032	1461
Sugar used mg.	1194	1336	1471	1468	1039
Econ. Fungus : sugar.	1.95	1.73	1.56	1.61	1.69
Coeff. Sugar : fungus	0.51	0.59	0.64	0.62	0.59
V as in I.					
Temp. circa 24°C. 5 days.					
Weight crop mg.	305	523	610	600	520
Sugar residue mg.	1912	1637	1536	1540	1164
Sugar used mg.	588	863	964	960	925
Econ. Fungus : sugar.	1.83	1.65	1.58	1.60	1.74
Coeff. Sugar : fungus.	0.55	0.60	0.64	0.62	0.59
VI as in I.					
Temp. circa 20°C. 7 days					
Weight crop mg.	308	527	622	580	489
Sugar residue mg.	1980	1620	1480	1525	1705
Sugar used mg.	620	880	1020	975	895
Econ. Fungus : sugar.	2.01	1.67	1.64	1.68	1.83
Coeff. Sugar : fungus.	0.50	0.61	0.60	0.62	0.55

TABLE II.

VII. *Penicillium glaucum*. $ZnSO_4$ added. Grown at room temperature. Harvested nine days after sowing. 100 cc. culture fluid in flasks 200 cc. capacity.

% $ZnSO_4$. Fraction normal $ZnSO_4$.	Control.	.002 % .000125	.004% .00025	.008% .0005	.032% .0020
VII.					
Weight crop mg.	430	613	940	836	503
Sugar left mg.	4093	3809	3130	3480	3500
Sugar used mg.	997	1191	1870	1520	1500
Econ. Fungus : sugar.	2.11	1.96	1.99	1.81	2.30
Coeff. Sugar : fungus.	0.46	0.51	0.50	0.55	0.46
VIII as in VII. Temp. circa 20°C. 9 days.					
Weight crop mg.	395	705	693	674	581
Sugar residue mg.	4048	3393	3409	3403	3559
Sugar used mg.	952	1607	1591	1597	1441
Econ Fungus : sugar.	2.41	2 28	2.31	2.37	2.48
Coeff. Sugar : fungus.	0.41	0.44	0.44	0.44	0.41
IX as in VII. Temp. circa 20°C. 8 days.					
Weight crop mg.	295	416	683	618	
Sugar residue mg.	4426	4322	3873	3937	
Sugar used mg.	574	678	1127	1063	
Econ. Fungus : sugar.	1.95	1.70	1.65	1.72	
Coeff. Sugar : fungus.	0.51	0.59	0.61	0.58	
X as in VII. Temp. circa 20°C. 8 days.					
Weight crop mg.	362	700	910	685	525
Sugar left mg.	4184	3710	3453	3550	3793
Sugar used mg.	816	1290	1547	1450	1207
Econ. Fungus : sugar.	2.26	1.85	1.70	2.12	2.30
Coeff. Sugar : fungus.	0.43	0.54	0.59	0.47	0.44
50 cc.	*Trichothecium roseum.*				
XI Conditions as in VII. *Trichothecium roseum.* Harvested 10 days after sowing. Temp. circa 22°C.					
Weight crop mg.	112	203	203	196	091
Sugar residue mg.	2231	2052	2064	2013	2278
Sugar used mg.	269	448	436	447	222
Econ. Fungus : sugar.	2.40	2.21	2.15	2.28	2.44
Coeff. Sugar : fungus.	0.41	0.45	0.48	0.44	0.41
XII as in XI. *Trichothecium roseum.* Temp. circa 22°C.					
Weight crop mg.	95	205	183	194	104
Sugar residue mg.	2298	2098	2152	2126	2281
Sugar used mg.	202	402	348	374	219
Econ. Fungus : sugar.	2.13	1.99	1.90	1.93	2.11
Coeff. Sugar : fungus.	0.48	0.51	0.53	0.52	0.46

TABLE III.

XIII. *Sterigmatocystis nigra.* Excess of Fe_2Cl_6 added. Temperature about 25°C. Harvested seven days after sowing. Culture flasks 125 cc. 50 cc. culture fluid.

% Fe_2Cl_6 Fraction normal Fe_2Cl_6.	Control.	0.050 % .0015	0.100 % .0003	0.200 % .0006
XIII.				
Weight crop mg.	320	515	710	700
Sugar residue mg.	1796	1516	1187	1205
Sugar used mg.	704	984	1313	1295
Econ. Fungus : sugar.	2.20	1.91	1.85	1.85
Coeff. Sugar : fungus.	0.45	0.52	0.54	0.54
XIV as in XIII. Temp. circa 23°C. 6 days.				
Weight crop mg.	285	491	683	694
Sugar residue mg.	1944	1616	1346	1369
Sugar used mg.	556	884	1154	1131
Econ. Fungus : sugar.	1 95	1.80	1.69	1.63
Coeff. Sugar : fungus.	0.51	0.55	0.60	0.62
XV as in XIII. Temp. circa 33°C. 6 days.				
Weight crop mg.	305	500	690	725
Sugar residue mg.	1890	1595	1355	1268
Sugar used mg.	610	905	1145	1232
Econ. Fungus : sugar.	2.00	1.81	1.66	1.70
Coeff. Sugar : fungus.	0.50	0.55	0.61	0.59
XVI as in XIII, but with 100 cc. Temp. circa 24°C. 6 days.				
Weight crop mg.	711	1240	1635	1610
Sugar residue mg.	3364	2446	2028	1796
Sugar used mg.	1636	2554	2972	3204
Econ. Fungus : sugar.	2.31	2.06	1.94	1.99
Coeff. Sugar : fungus.	0.46	0.49	0.52	0.50

TABLE IV.

XVII. *Penicillium glaucum.* Excess of Fe_2Cl_6 added. Temp. about 20°C. Harvested nine days after sowing. Culture flasks 125 cc. 50 cc. culture fluid.

% Fe_2Cl_6. Fraction normal Fe_2Cl_6.	Control.	0.051 % .00015	0.10 % .0003	0.20 % .0006
XVII.				
Weight crop mg.	160	300	410	390
Sugar residue mg.	2108	1837	1627	1650
Sugar residue mg.	392	663	873	850
Econ. Coeff. Fungus : sugar.	2.45	2.21	2.13	2.18
Econ. Coeff. Sugar : fungus.	0.41	0.45	0.47	0.45
XVIII *Penicillium* as in XVII Temp. circa 21°C. 7 days.				
Weight crop mg.	148	273	386	420
Sugar residue mg.	2155	1930	1672	1647
Sugar used mg.	342	570	818	853
Econ. Coeff. Fungus : sugar.	2.31	3.09	2.12	2.03
Econ. Coeff. Sugar : fungus.	0.43	0.46	0.46	0.49
XIX *Penicillium* as in XVI 100 cc. Temp. circa 19°C. 8 days.				
Weight crop mg.	375	830	1,012	.981
Sugar residue mg.	4128	3324	3148	3125
Sugar used mg.	872	1676	1852	1875
Econ. Coeff. Fungus : sugar.	2.30	2.02	1.83	1.91
Econ. Coeff. Sugar : fungus.	0.43	0.49	0.54	0.52
XX *Penicillium* as in XIX 100 cc. Temp. circa 19°C. 10 days.				
Weight crop mg.	546	945	1.270	1.348
Sugar residue mg.	3890	3265	3450	2816
Sugar used mg.	1110	1735	1550	2184
Econ. Coeff. Fungus : sugar.	2.03	1.84	1.22	1.62
Econ. Coeff. Sugar : fungus.	0.49	0.54	0.82	0.62
XXI *Penicillium* as in XIX 100 cc. Temp. circa 19°C. 9 days.				
Weight crop mg.	280	463	617	680
Sugar residue mg.	4385	4074	3891	3810
Sugar used mg.	615	926	1109	1190
Econ. Coeff. Fungus : sugar.	2.16	2.00	1.71	1.75
Econ. Coeff. Sugar : fungus.	0.46	0.50	0.58	0.58

TABLE V.

Average of $ZnSO_4$ Cultures.

% $ZnSO_4$. Fraction Normal $ZnSO_4$.	Control.	.002% .000125	.004% .00025	.008% .0005	.032% .002
Sterigmatocystis, 6 series.					
Average weight crop mg.	438	695	853	780	471
Econ. Fungus : sugar.	1.91	1.65	1.45	1.47	1.76
Coeff. Sugar : fungus.	0.52	0.60	0.69	0.68	0.57
Penicillium, 4 series.					
Average weight crop mg.	370	650	807	707	402
Econ. Fungus : sugar.	2.20	1.98	1.85	1.90	2.35
Coeff. Sugar : fungus.	0.45	0.52	0.54	0.53	0.44
Av. Econ. Coeff, both fungi.					
Fungus : sugar.	2.05	1.83	1.65	1.73	2.00
Sugar : fungus.	0.48	0.56	0.62	0.60	0.50

Average of Fe_2Cl_6 Cultures.

% Fe_2Cl_6. Fraction Normal Fe_2Cl_6.	Control.	.050% .00015	.10% .0003	.20% .0006
Sterigmatocystis, 4 series.				
Average weight crop mg.	316	532	725	731
Econ. Fungus : sugar.	2.11	1.89	1.78	1.79
Coeff. Sugar : fungus.	0.48	0.52	0.56	0.56
Penicillium, 5 series.				
Average weight crop mg.	354	660	881	906
Econ. Fungus : sugar.	2.25	2.07	1.80	1.90
Coeff. Sugar : fungus.	0.44	0.48	0.55	0.52
Av. Econ. Coeff., both fungi.				
Fungus : sugar.	2.18	1.98	1.79	1.85
Sugar : fungus.	0.46	0.50	0.56	0.54

TABLE VI.

Series with LiCl added. XXII., XXIII., *Sterigmatocystis;* XXIV.–XXVI., *Penicillium;* XXVI., *Trichothecium.* All in 125 cc. flasks with 50 cc. culture fluid.

% LiCl. Fraction normal LiCl.	Control.	0.125% .03	0.250% .06	0.375% .09
XXII. *Sterigmatocystis.*				
Temp. circa 24°C. 8 days.				
Weight crop mg.	295	435	420	681
Sugar left mg.	1778	1539	1580	1090
Sugar used mg.	722	961	920	1410
Econ. Fungus : sugar.	2.45	2.21	2.19	2.07
Coeff. Sugar : fungus.	0.41	0.45	0.45	0.49
XXIII. *Sterigmatocystis.*				
Temp. circa 23°C. 6 days.				
Weight crop mg.	315	451	532	610
Sugar left mg.	1892	1733	1617	1548
Sugar used mg.	608	767	833	952
Econ. Fungus : sugar.	1.93	1.70	1.66	1.56
Coeff. Sugar : fungus.	0.52	0.59	0.60	0.64
XXIV. *Penicillium.*				
Temp. circa 18°C. 9 days.				
Weight crop mg.	180	290	301	466
Sugar residue mg.	2115	1940	1964	1699
Sugar used mg.	385	560	536	801
Econ. Fungus : sugar.	2.15	1.93	1.78	1.72
Coeff. Sugar : fungus.	0.48	0.52	0.56	0.58
XXV. *Penicillium.*				
Temp. circa 20°C. 7 days.				
Weight crop mg.	135	242	288	501
Sugar residue mg.	2224	2085	2031	1712
Sugar used mg.	256	414	469	787
Econ. Fungus : sugar.	1.90	1.71	1.63	1.57
Coeff. Sugar : fungus.	0.52	0.59	0.60	0.61
XXVI. *Penicillium.*				
Temp. circa 19°C. 9 days.				
Weight crop mg.	121	264	303	285
Sugar residue mg.	2231	1964	1924	1950
Sugar used mg.	269	536	576	550
Econ. Fungus : sugar.	2.22	2.03	1.90	1.93
Coeff. Sugar : fungus.	0.45	0.49	0.53	0.52
XXVII. *Trichothecium roseum*				
Temp. circa 20°C. 8 days.				
Weight crop mg.	101	195	276	344
Sugar residue mg.	2286	2143	1986	1877
Sugar used.	214	357	513	623
Econ. Fungus : sugar.	2.12	1.94	1.86	1.81
Coeff. Sugar : fungus.	0.47	0.52	0.54	0.55

TABLE VII.

Sterigmatocystis nigra. XXVIII.–XXX. with $NiSO_4$. XXXI. and XXXII. with Cocaine. Otherwise as in previous cultures. 50 cc. culture fluid.

% $NiSO_4$ Fraction Normal $NiSO_4$.	Control.	0.008 % .0005	0.016 % .001	0.033 % .002
XXVIII Temp. circa 24°C. 7 days				
Weight crop mg.	250	360	885	210
Sugar residue mg.	2043	1916	1156	2099
Sugar used mg.	457	584	1344	401
Econ. Fungus : sugar.	1.83	1.60	1.52	1.91
Coeff. Sugar : fungus.	0.55	0.62	0.67	0.53
XXIX as in XXVIII. Temp. circa 24°. 7 days.				
Weight crop mg.	231	365	430	215
Sugar residue mg.	1969	1740	1714	2010
Sugar used mg.	530	760	786	490
Econ. Fungus : sugar.	2.30	2.14	1.92	2.28
Coeff. Sugar : fungus.	0.44	0.48	0.53	0.44
XXX as in XXVIII. Temp. circa 23°. 7 days.				
Weight crop mg.	305	482	595	300
Sugar residue mg.	1835	1555	1455	1860
Sugar used mg.	665	945	1045	640
Econ Fungus : sugar.	2.18	1.95	1.76	2.13
Coeff. Sugar : fungus.	0.46	0.51	0.57	0.47
XXXI Cocaine, otherwise as in XXVIII.	Control.	0.1 %	0.2 %	
Weight crop mg.	360	520	600	
Sugar residue mg.	1658	1382	1192	
Sugar used mg.	842	1118	1308	
Econ. Fungus : sugar.	2.34	2.15	2.18	
Coeff. Sugar : fungus.	0.42	0.48	0.46	
XXXII Cocaine, otherwise as in XXVIII.				
Weight crop mg.	275	510	591	
Sugar residue mg.	1929	1557	1616	
Sugar used mg.	572	943	884	
Econ. Fungus : sugar.	2.08	1.85	1.80	
Coeff. Sugar : fungus.	0.47	0.54	0.55	

New Plants from Wyoming.—X

By Aven Nelson

Potentilla glomerata

Stems stout, one to several from the thickened woody root, ascending or at length nearly erect, simple, 4–8 dm. high, softly and sparingly hirsute: leaves simple, the radical long-petioled (1–3), the cauline on petioles gradually shorter upwards, the uppermost sessile or nearly so; stipules from oblong to ovate, entire or incised; leaflets oblong or narrowly obovate, subcuneate at base, 3–8 cm. long, pinnately cleft into long, oblong, mostly obtuse teeth, green but finely pubescent above, a close fine whitish pubescence below with a longer pubescence on the veins: inflorescence congested-glomerulate in a few of the upper axils; hypanthium silky, in fruit 8–10 mm. across; bractlets oblong, subacute, shorter than the sepals; sepals lanceolate; corolla small, the petals yellow, nearly orbicular, not exceeding the sepals.

This is another member of the section Graciles as constituted by Dr. Rydberg in his monograph of the N. A. Potentilleae. Of the species there described it is probably nearest to *Nuttallii* Lehm.* from which its simple stems, subtomentose leaves and the strikingly congested inflorescence distinguish it. It is noticeably large-leaved and the stems are stoutish, the leaves becoming smaller and the stems virgate upward.

The type plants were collected on Bear River at Evanston, July 27, 1897, no. 4115. Collected also on Bear River at Cokeville, June 11, 1898, no. 4646.

Castilleja longispica

Perennial, tufted: stems few to many, 2–3 dm. high, branched, the branches slender, erect, closely approximated (fascicled): pubescence of two kinds—a short-hirsuteness with a fine puberulence: leaves slender, 2–5 cm. long, 3-cleft to the middle or thereabouts into linear lobes, the middle lobe largest: bracts with dilated base, 3-cleft to the middle or beyond, the middle lobe oblong, obtuse, the lateral linear: spikes dense, slender, half the whole length of the plant, yellowish: calyx lobes equal, linear-lanceolate, acuminate, a little shorter than the ovoid tube: corolla 12–15 mm. long, ⅓ longer than the calyx and slightly exceeding the bracts: lip triply saccate, and conspicuously 3-toothed, the sacs shallow: galea broadish, obtuse or subacute, sometimes with a small tooth near the apex, slightly longer than the teeth of the lip.

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* In my opinion, it is very closely related to *P. Blaschkeana.* I included it in that species in my Monograph, but am now inclined to believe it to be distinct. It differs from that species in less deeply cut leaves and much less dense tomentum.—P. A. Rydberg.

This plant has been distributed as *Orthocarpus pallescens* Gray, intermingled possibly with some authentic specimens of that species. Both were collected in the same locality and unfortunately were not discriminated and so were distributed ticketed as below. Though perhaps as nearly related to that species as to any other, yet the proposed species is very distinct. Its fascicled branches with their long slender spikes give it a characteristic habit; its equally lobed (4) calyx and its 3-toothed lip which nearly equals its short and broad galea will aid in distinguishing it. The only collection of it at hand is no. 900, Gros Ventre river, Aug. 15, 1894, in part.

Oonopsis argillacea

Tufted, caespitose, the short branches of the multicipital caudex barely reaching the surface of the soil, the crowns more or less covered with the bases of dead leaves: stems numerous, 3–8 cm. long, simple as to the base, terminating in a leafy corymbose inflorescence of few heads, permanently sparsely lanate-pubescent as are also the leaves: leaves entire, narrowly to broadly linear, pungently acute, tapering at the base (those on the crown somewhat petiolate), 4–8 cm. long, many at length overtopping the heads: involucre tomentose, about 1 cm. high, its bracts oblong-ovate, acuminate, not conspicuously green-tipped: rays showy, about 10, the disk flowers twice as many: style appendages lanceolate, as long or longer than the stigmatic portion: pappus moderately abundant, but little shorter than the corolla tube, slightly fulvous: akene softly pubescent, oblong, 3–4 mm. long.

Allied to *O. multicaulis* (Nutt.) Greene, but distinguished by its less ligneous base, much longer leaves which overtop the stems, more numerous heads and rays, longer and more abundant pappus and different style appendages. This occurs on naked clay slopes and flats, a habitat quite in contrast with that of *O. multicaulis*.

Secured by Mr. E. Nelson in Bate's Hole, Carbon Co., July 13, 1898, no. 4867; also on Wallace Creek, near Garfield Peak, July 30, 1898, no. 5009.

Petradoria pumila petiolaris

Tufted like the species, 10–20 cm. high: the branches of the caudex crowded, slender and more numerous, the crowns clothed with dead leaf bases: basal leaves numerous, narrowly linear, on slender (nearly filiform), petioles which are ⅓–½ as long as the blade; stem leaves also linear and petioled: inflorescence similar to that of the species, but less flat-topped and fewer flowered, scarcely surpassing the relatively long leaves.

This plant was secured in 1897, July 17, no. 3581, in the southern portion of Sweetwater County. It occurred in some abundance on stony hillsides in situations similar to that frequented by the species. The species *Petradoria pumila* (Nutt.) Greene was obtained in the same range during that season. The narrow leaves and their much greater relative length gives the variety a very different aspect, but I think the difference can hardly be considered specific.

Tetradymia multicaulis *

Wholly unarmed; the shrubby base tufted, much branched, spreading-assurgent, hardly emergent from the soil: the herbaceous annual stems numerous, somewhat fascicled, simple, erect, 8–15 cm. long, permanently canescent with a dense, appressed tomentum: leaves numerous but not fascicled, narrowly oblong with tapering ends, acute at apex, nearly sessile, like the stems permanently canescent, 15–25 mm. long, midrib usually evident, the pair of lateral nerves obscure: flowers in very compact, terminal clusters of 10–20 heads with bract-like leaves intermingled; heads 12–14 mm. high, four-bracted and four-flowered: pappus copious: akenes villous.

In color of stems and foliage and in floral characters it closely resembles *T. canescens* DC. and *T. inermis* Nutt. but in its caespitose habit it is strikingly different. The numerous erect herbaceous stems are about all that appears above the surface of the soil. It should be noted, too, that these stems are unbranched, in striking contrast with the before mentioned members of this group. The leaves are broader and the venation more conspicuous.

Collected on the Laramie Plains, not far from Laramie, June 24, 1897, by Mr. Elias Nelson. Type specimen in the herb. Univ. of Wyoming, no. 3442.

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* Since the description of this species was written more than a year has elapsed and the plant has been carefully observed in the field and again collected as no. 5062. The characters as given are fully confirmed by these later observations and collections.

Senecio Laramiensis

Tufted, perennial: the branches of the caudex with one to several, leafy crowns, permanently white-tomentose, somewhat floccose in age, 1–3 dm. high: stems few to several, slender, ascending, the sparse leaves rather uniform, becoming bract-like in the inflorescence only: basal leaves crowded, linear, rarely narrowly oblanceolate, entire, 4.8 cm. long; stem-leaves similar: inflorescence a corymbose cyme, of few to several heads: heads 10–12 mm. high; calyculate bracts few, small and inconspicuous or none: rays few (10, more or less): akenes oblong, glabrous, inconspicuously striate.

Senecio canus Hook. as represented in herbaria includes several forms that when better understood will probably be considered distinct. The species now proposed is one of the most divergent of these. In fact, it is so different in habit and general appearance that at first one is not inclined to associate it with *S. canus*, but rather with *S. werneraefolius* Gray. Critical examination shows, however, that it is much more nearly related to the former, from which its smaller size and narrow entire leaves are the obvious, superficial characters separating it. It is abundant in the vicinity of Laramie, on the naked, red clay hills. Distributions have been made to many herbaria as *S. werneraefolius* under nos. 224 and 1379. I have seen no specimens of this except the numbers cited and other collections from the same localities.

Senecio Nelsonii Rydb.*

Many-stemmed from a densely tufted caudex whose numerous branches are reduced to short leafy crowns, green and nearly glabrous, the thin tomentum unequally distributed and most of it early deciduous: leaves very numerous, crowded on the crowns and several on the stems, oblong, lanceolate, or oblanceolate in outline, from pinnately toothed to deeply lobed or sometimes divided nearly to the midrib, the segments obtuse or acute, often incisely toothed; stem-leaves slightly reduced upward: stems 2–4 dm. high, simple, terminating in a crowded, corymbose cyme, the upper pedicels subumbellate: heads 7–10 mm. high, calyculate bracts small, only 1 or 2; rays few (6–12), rather large: akenes brown, glabrous, distinctly striate, 2–3 mm. long.

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* Professor Nelson had given another name in his manuscript, but that name is a homonym. In his absence on a botanical expedition, I take pleasure in dedicating this species to the discoverer and describer.—P. A. R.

When this was first secured it was confused with *Senecio Fendleri* Gray under which name I have distributed specimens no. 1297, Centennial Hills, June 9, 1895. *S. Fendleri* is, however, a very different plant as I found on examining at the Missouri Botanical Garden, Fendler's nos. 478 and 480, preserved in the Engelmann Herbarium. These are large plants with the appearance of having grown as single, simple, stout, erect individuals, with an open, corymbosely branched inflorescence. Besides, *S. Fendleri* is lanate on stems and involucre.

S. Nelsonii is abundant in the foothills in southern Wyoming, occupying mostly steep naked stony or sandy slopes. Besides the number given, it has been collected also at Green Top, June 28, 1897, no. 3217.

Senecio Nelsonii Uintahensis

Habit and habitat of the species: basal leaves with long slender petioles, all deeply divided, the lobes irregularly and incisely dentate; stem-leaves fewer, similar to the basal but with petioles shorter, sessile above.

This variety is possibly largely a geographical one. The species occurs on stony, sandy slopes in the eastern part of the state while the variety has been secured only in the western. No. 4511, Evanston, June 4, 1898.

Tanacetum simplex

Caudex of few short crowded branches, covered with dead leaf bases, the crowns scarcely above the surface of the ground: leaves crowded on the crowns, closely and finely appressed-silvery-canescent, erect, mostly simple and linear, a few bifid or trifid at apex, only 2–3 cm. long: stems few, rising singly from the crowns (many of the crowns leaf-bearing only), slender, 6–12 cm. high, bearing 2–5 small linear leaves and a single head: head 6–8 mm. high, many-flowered: involucral bracts oval to obovate, in two rows, with slightly thickened greenish midrib and scarious margins: corolla tubes thin and somewhat transparent: the female flowers in one series: akenes oblong, or slightly enlarged upward, obtuse: pappus none: receptacle conical.

Probably closest to *Tanacetum canum* Eaton. Collected near Laramie on a stony slope in the foothills, no. 4325, May 30, 1898. Certainly rare and far from abundant even in the type locality.

Artemisia Natronensis.

A. Ludoviciana integrifolia Aven Nelson, First Rep. Fl. Wyo. 138. 1896.

Stems herbaceous, from a woody persistent crown, suberect, simple, virgate, silvery white-tomentose as are also the leaves, floriferous for nearly half their length, 3–6 dm. high: leaves broadly linear to lanceolate, nearly equally tomentose on both sides, in age the margins revolute, the midrib becoming conspicuous below and the tomentum looser: panicle narrow, its raceme-like clusters in the axils of the leaves which become gradually smaller and bract-like upward or wholly wanting on the summit: heads rather large, campanulate, about 5 mm. high, in small axillary racemes (often only 1–3 heads in each cluster), erect or nearly so even at maturity, about 20-flowered; the bracts ovate to oval: corolla resinous-dotted on the tube only or but sparsely so on the throat and lobes.

A. Ludoviciana as represented in the herbaria is, as every one knows, a composite. Nuttall's description excludes several forms that are often included but are undoubtedly distinct. The species now proposed is one of the forms that I think is clearly separable by valid characters. Possibly it may be *A. integrifolia* Pursh but that name is much antedated. That it is *A. Purshiana* Bess. or *A. Hookeriana* Bess. seems, from the descriptions, improbable. From *A. Ludoviciana* its entire leaves, narrow, virgate panicles, large erect heads and broad involucral bracts distinguish it. The numerous small, crowded heads of the inflorescence of *A. Ludoviciana* are on more or less recurved pedicels and the florets are smaller and resin-dotted throughout.

Type no. is 568, Willow Creek, July 20, 1894, distributed as a variety of *A. Ludoviciana* as given above. Excellent specimens have been collected by Mr. Elias Nelson, Wallace Creek, July 30, 1898, no. 5002—from Natrona county, whence the name.

Malacothrix runcinata

Annual or possibly biennial, leafy on the crown and sparingly so on the stems, mostly glabrous and somewhat glaucous, rarely with small patches of woolly pubescence: stems one to several from the crown of the slender tap-root, erect or, when several, decumbent at base, 5–15 cm. long: leaves rather small, 2–4 cm. long, oblanceolate to linear in outline, from dentate to runcinate: heads one to several on each stem, 8–12 mm. high: involucre broadly campanulate, its bracts in about three series, some of them dark or purplish-tipped, scarious-margined, linear-lanceolate, subacute, the innermost slightly acuminate: pappus of 12–18 subequal bristles all deciduous together in a ring, 2–3 times as long as the akene: receptacle apparently naked: akenes linear-columnar, about 3 mm. long, the 15 striae subequal, minutely denticulate around the summit.

Probably most nearly allied to *M. sonchoides* T. & G. but the two plants when seen side by side present a very different appearance. The dentate rachis and lobes of the leaves, the dentate outer involucral bracts, the unequally striate akenes and double pappus of *M. sonchoides* are marks easily distinguishing it from *M. runcinata.*

It occurs on dry, sandy slopes, mostly in the protection of the undershrub. Green River, June 15, 1898, no. 4727; Fort Steele, June 18, 1898, no. 4819.

Lactuca sylvatica

Perennial from rootstocks: stem slender, leafy, the internodes gradually shorter upward, glabrous: leaves entire, oblong-lanceolate, the lower tapering into a margined petiole, the upper sessile, thin and wholly glabrous, the largest 10–14 cm. long and 2–3 cm. wide, gradually smaller upward (the uppermost scarcely more than bracts): panicle rather close, of 10–20 heads, its branches more or less short-bracteate: heads 2 cm. high, about 15-flowered: the involucral bracts in about 4 series; the outer short, ovate; the inner linear-lanceolate: flowers blue or lilac: akenes 5 mm. long, lanceolate-oblong, distinctly margined and conspicuously beaked, 4-nerved on each side: the beak nearly half as long as the body of the akene.

Probably to be associated with *Lactuca pulchella* but differing in its entire leaves and margined akenes. The larger akene, longer beak and its broadly expanded summit are also at variance with that.

Collected at Elk Mountain on Medicine Bow River in the copses on the bank, August 1897, no. 4257.

Crepis riparia

Tap-root semi-fleshy, comparatively small, mostly less than 1 dm. long: stems one or more, 2–4 dm. high, subscapose (linear, bract-like leaves at the base of the lower branches of the panicle and sometimes a single leaf near the base of the stem), minutely and sparsely pubescent below, the pubescence more conspicuous upward and becoming clammy or (on the pedicels) glandular: radical leaves few, rather large, oblong to elliptic, obtuse to subacute, entire or coarsely and irregularly dentate and at base more or less runcinate, 10–18 cm. long, on petioles of about half the length, glabrous except on the petioles and midrib: inflorescence corymbose-paniculate, the few to several heads of the branches of the panicle being crowded at their summits: heads 15–20 mm. high, many-flowered : involucre dark, glandular-pubescent: bracts linear, in two rows; the outer few and short; inner more numerous (12–16): akenes tapering gradually from base to summit, about 6 mm. long, rather uniformly 10-striate, light brown: pappus soft and white, shorter than the akene.

A few specimens were distributed as no. 1857 (Centennial Valley, Aug. 25, 1895) under the name *Hieracium Fendleri* Schultz Bip. From this it is clearly distinct, however.* The only specimens duplicating the number cited above that I have seen were collected by T. A. Williams and also distributed as *H. Fendleri*.

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* Its nearest relative is *C. runcinata* T. & G., but is easily distinguished from that species by the larger, more distinctly turbinate head and larger leaves which are much more deeply runcinate at the base.—P. A. R.

The Advantages of 1737 as a Starting Point of Botanical Nomenclature*

By Dr. Otto Kuntze

At request of the editor of this journal [*Gaertnerisches Zentralblatt*], I give the following newly proved list of generic names, that do not need to be changed if the starting-point of 1735 is abandoned. The numbers before the names are the approximate number of species :

15	*Aesculus* (*Pavia* 1735).
30	*Ageratum* (*Carelia* 1736).
45	*Ajuga* (*Bulga* 1735).
58	*Arctotis* (*Anemonospermos* 1736).
1400	*Astragalus* (*Tragacantha* 1737) incl.:
150	*Spiesia* = *Oxytropsis* according to Briquet and Burnat.
23	*Bulbine* (*Phalangium* 1736).
21	*Carica* (*Papaya* 1735).
8	*Carpesium* (*Conyzodes* 1736).
1	*Cassandra* (*Hydragonum* 1736).
132	*Clitoria* (*Ternatea* 1735).
3	*Coix* (*Sphaerium* 1735).
1	*Convallaria* § L. (*Majanthemum* 1736). [§ is the sign for group (section, subgenus or discretionary genus); § L. 1737 means a group of Linnaeus.]
230	*Cordia* (*Lithocardium* 1735).
6	*Corrigiola* (non 1736.)
170	*Crepis* (*Hieraciodes* 1736), if separated.
600	*Croton* (*Oxydectes* 1735).
1	*Cuminum* (non 1735).
180	*Cynanchum* (*Vincetoxicum* 1736) sensu latiore.
1	*Dryas* (*Dryadaea* 1735) .
72	*Echinops* (*Sphaerocephalus* 1735).
12	*Elatine* (*Potamopithys* 1735).

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* Translated by the author from the *Gaertnerische Zentralblatt*, Berlin, 1899, No. 2. The article contains a new motive for 1737 and at the last a new international proposition not yet known to American botanists.

400 *Erica* Ludw. 1737 (*Ericodes* Möhr. 1736).—*Erica* L. 1737 is partly *Calluna* Salisb. 1802 = *Ericodes* Ludw. 1737 (non Moehr.), z. T. *Erica* Ludw.—Linnaeus' indication "*Semina numerosa*" is only fit for *Erica* Ludw., because *Ericodes vulgare* O. K. (*Calluna vulg.*) has at most 8 seeds.

34 *Erythrina* (*Corallodendron* 1735).

8 *Feuilléea* (non 1735).

5 *Galanthus* (*Chianthemum* 1736).

2 *Galeopsis* (*Ladanum* 1735).

180 *Geranium* § L. 1737; 1753 ex parte max. (*Geraniospermum* Sieg. 1736 = *Pelargonium!* Burm. 1738); eventually incl.

— *Gruinalis* § L. 1737, Ludw. 1737, Haller 1745 (*Geranium* Sieg., L'Hér.).—Linnaeus distinguished 1737 (in Genera Plant.: 204) under *Geranium* in an observation: *Geranium* "Riv.," corolla irregulari. *Gruinalis* "Riv.," corolla aequali et filamentis vix manifeste coalitis. Haller in Flora Jenensis 1745 had under *Gruinalis* only species which we call now *Geranium*. Nearly all species of *Pelargonium* are already named under *Geranium*, and *Geranium* is still a popular name of several nations instead of *Pelargonium*. But it would not be necessary to name the species under *Gruinalis*, because both genera are better united again, as all indicated differences are not decisive, varying from species to species.

90 *Gomphrena* (*Xeraca* 1735).

30 *Helenium* (non 1735).

1 *Illecebrum* (non 1736).

400 *Inga* § L. 1737 (*Feuilléea* 1735) sensu latiore.

90 *Inula* (*Helenium* 1735).

1 *Lagoecia* (*Cuminium* 1735).

100 *Lepidium* (*Nasturtium* 1735).

12 *Linnaea* (*Obolaria* 1736).

1 *Lunularia* (*Marsilia* 1735).

23 *Melilotus* (*Sertula* 1735).

4	*Melia* (*Azedarach* 1735),
13	*Michelia* (non 1735).
156	*Nepeta* (incl. *Glechoma* 1735).
1	*Obolaria* (non 1736).
8	*Ornithopus* (*Ornithopodium* 1735).
2	*Patagonula* (*Patagonica* 1735).
220	*Oxalis* (*Acetosella* 1736).
27	*Phlox* (*Armeria* 1735).
540	*Phyllanthus* (*Diasperus* 1735) sensu latiore.
10	*Pistacia* (*Lentiscus* 1735).
110	*Psidium* (*Guajava* 1736), if separated.
105	*Psoralea* (*Lotodes* 1736).
120	*Rhus* (*Toxicodendron* 1735).
15	*Sesamum* (*Volkameria* 1735).
54	*Sisyrinchium* (*Bermudiana* 1735).
80	*Stapelia* (*Stissera* 1735).
115	*Thesium* (*Linosyris* 1736).
48	*Tropaeolum* (*Trophaeum* 1735).
75	*Trigonella* (*Telis* 1735).
44	*Trichosanthes* (*Anguina* 1735).
1	*Zea* (*Thalysia* 1735).

6285 species in *58* genera with long-used names remain thus valid. But 329 species in 9 genera, valid from the former starting point, receive new names; therefore *5956* species in *49* genera are spared, that is, are less to be changed, in their names, if we begin with 1737 instead of 1735. But this is the only profitable deviation from the Paris Code.

Moreover, the starting of 1737 affords the great advantage, that Linnaeus' Genera Plantarum 1737 contains besides the scientific diagnoses of the genera (which are in 1753 without diagnoses!) also definitions for named subgenera or discretionary genera; by which means an easy separation is possible into later distinguished genera. Linnaeus wrote, for instance: *Hyacinthus*, genus hocce naturale in plura non naturalia distribuerunt: (*α*) *Hyacinthus* quum tubus corollae sit tubulatus oblongus: (*β*) *Muscari* quum tubus corollae sit fere globosus. In the same manner is distinguished *Convallaria* (*α*) from (*β*) *Polygonatum*, (*γ*) *Unifolium*. The last is now mostly valid for *Majanthemum*. In the year 1737 *Myagrum*

§ L.: *Rapistrum* § L.—is clear although united under *Myagrum*; in the year 1753, when these sections (§ = subgenera = genera discretionaria) are omitted, we must decide *ex parte majore*, else the matter loses its clearness and becomes confused. The case is the same in *Calendula* and § *Dimorphotheca*, *Helianthemum* and *Cistus*, etc. The following names are thus obtained from the §§ of 1737 for later renewed genera: *Acacia*, *Alhagi*, *Arnica****, *Arisarum*, *Bernhardia*, *Bulbocodium**, *Cakile*, *Camara*, *Cannabina**, *Capnodes*, *Capnorchis**, *Castanea***, *Ceratodes*, *Cereus***, *Colocynthis**, *Damasonium*, *Dimorphotheca*, *Dracunculus*, *Echinophora*, *Elephas*, *Foeniculum***, *Helianthemum*, *Helleborodes**, *Hypocistis*, *Jonthlaspi*, *Lantana* § (= *Oftia*), *Lasianthus****, *Leuconymphaea** (= *Nymphaea auct. recent.!*), *Nymphaea* (= *Nuphar!*), *Liliastrum*, *Limonium*, *Majorana*, *Malvaviscus*, *Meibomia**, *Melilotus*, *Melocactus*, *Muscari*, *Nelumbo*, *Myagrum*, *Onobrychis*, *Opuntia*, *Paliurus*, *Polygonatum*, *Raphanistrum*, *Rapistrum*, *Rhagadiolus*, *Securidaca* (*Securigera* DC.), *Statice*, *Symphoricarpus*, *Thymbra**, *Triosteospermum*, *Trollius**, *Tulipifera*, *Unifolium*, *Zacintha***.—(One * means that Linnaeus gave such an * to these names in the index of his Genera Plantarum; ** means that Linnaeus had that name in 1735 for a genus; *** indicates both.)

From these discretionary genera considered by Linnaeus and other authors at one time as genera, at another time as sections, a systematic decision is easy; only two dubious cases occur: the first rare case is that the same group (*a*) received two names, such as *Sida* and *Malvinda*; then the genus name, which received first a species name, is valid. The other case is that three to four names occur for the same now united group; then the name under which they were first correctly united, is to be valid. For instance, *Lonicera* 1737 consists of four genera and is thus confused; Haller after exclusion of the genera not belonging thereto, first united *Caprifolium*, *Periclymenum*, *Chamaecerasus*, *Xylosteum* under *Caprifolium*. *Lobelia* Pl. is correctly defined as a § and is therefore to be excluded; the rest was named then at first *Rapuntium*, under which name most of the species are already named in the monograph of Presl. Some genera would have to receive new names, if their name were not secured from the § of 1737, *e. g.*, *Helianthemum*. The name *Cactus*, after exclusion of the §§ of 1737, remains good for the remaining part.

In contrast to these great advantages and savings of the *1737*-starting-point, there are—see my Revisio Generum III^{II}, chapter 27 and 28—to be changed with the *1753*-starting-point the names of *7100* species and *129* genera, whereof only 29 genera with 152 species are named up to the present time. Furthermore *46* genera thereof with *3621* species would have still to receive new and unusual names instead of those introduced from the earlier starting-point. But even with this the number of these changes is not finished, because the starting-point of 1753 for genera has not yet been completely worked out. This 1753-starting-point is thus not only horribly *noxious* but also *unscientific*, as it misses the genera-diagnoses and nearly all the named genera-sections. *Only the 1737-starting-point is practicable, scientific, and economical for genera.* Perhaps a general convention may be agreed upon to the effect that the 1737-starting-point be valid for genera, 1753 for species *with future exclusion of all intermediate works*, that is of all publications between Linnaeaus' Genera Plantarum 1737 and Species Plantarum 1753.

New Fungi from Mississippi

By S. M. Tracy and F. S. Earle

Descriptions of other fungi from Mississippi have been published by the authors in this Bulletin, **22**: 174–179, and **23**: 205–211, and lists of all parasitic species known from the state in Bulletins 34 and 38 of the Mississippi Agricultural Experiment Station. The following additions are from the Gulf Coast and adjacent islands, a region that has already afforded a large number of new or local species, both among fungi and the higher plants. Types of the following are in the herbaria of the authors, and duplicates from the same collections have been placed in the herbaria of Columbia and Harvard Universities, Rutgers College, Missouri Botanical Garden and other institutions.

Aecidium Stillingiae

Hypophyllous or rarely amphigenous: spots definite, bright yellow, 1 cm. or more in diameter: pseudoperidia densely crowded, cylindrical, elongated, .5–.75 mm., irregularly lacerate and recurved, cells quite uniformly pentagonal, conspicuously roughened by ridge-like folds, 25–30 μ; aecidiospores light yellow, subspherical, epispore thick, slightly roughened, 22–29 μ.

On leaves of *Stillingia ligustrina*, Wisdom, Miss., June 14, 1897, S. M. Tracy, no. 3413. Also previously collected at Ocean Springs, Miss.

Ustilago caricicola

Involving occasional spikes, only slighty distorting the inflorescence: spore masses hard, brown, 2–5 mm. in diameter, externally fibrous and almost wool-like; spores mostly ovoid, minutely echinulate, slightly fuscous, about 6 × 4 μ.

On *Carex folliculata*, Augusta, Miss., June, 1897, S. M. Tracy, no. 3343; Beauvoir, Miss., May, 1898.

Ustilago Psilocaryae

Involving but not destroying the ovaries, transforming the seeds into black powdery masses: spores lenticular, dark brown, opaque, epispore thick, reticulated, 10–14 μ in diameter, 6–8 μ thick.

On *Psilocarya rynchosporioides*, Horn Island, Miss., Oct., 1894, and Oct., 1898, S. M. Tracy, no. 5226.

Sorosporium rynchosporae P. Henn.

On *Rynchospora semiplumosa*, Biloxi, Miss., June, 1898, S. M. Tracy, no. 5225.

This South American smut is new to the United States.

Cerebella Anthaenantiae

Destroying the ovaries: stomatic mass globose, 3–5 mm. in diameter, at first reddish-orange, becoming velvety black with the maturity of the dark colored spores: glomerules subglobose, composed of several, sometimes 10 or 12, connate spores that are quite variable in size, the larger 20–24 μ; separate spores ovoid or angular from pressure, fuscous, average size 10–12 μ × 8–10 μ.

On *Anthaenantia rufa*, Ocean Springs, Miss., fall of 1890. Biloxi, Miss., Oct., 1894 and 1898, S. M. Tracy, no. 5219.

This form was mentioned in Bull. Miss. Ag. Exp. Sta. **34**: 94 under *C. Paspali* and was then tentatively referred to that species.

Cerebella Panici

Infesting the ovaries: stomatic mass oval, 1.5–3 mm. often covering the glumes, nearly black throughout: glomerules depressed-spherical, composed of 3–5 spores, dark-olivaceous, smooth or minutely roughened, 10–12 μ × 8–10 μ, remains of pedicel usually distinct; spores ovoid, angular on inner sides, about 8 × 6 μ.

On *Panicum virgatum*, Ocean Springs, Miss., 1891; Biloxi, Miss., Oct., 1898, S. M. Tracy, no. 5217.

Mentioned in Bull. Miss. Ag. Exp. Sta. **34**: 94 and there referred to *C. Paspali.*

Cerebella Sorghi

Infesting the ovaries: stomatic mass globose, 5–6 mm. in diameter, enveloping the glumes, dark or black throughout: glomerules subglobose, usually composed of three spores, smooth or slightly roughened, brown, 8–10 μ in diameter; spores ovoid, 6–8 × 5–6 μ.

On *Sorghum nutans*, Manuel, Jackson Co., Miss., Sept., 1898.

The form on *Chrysopogon avenaceus* from Tuskegee, Ala., that was referred to *C. Andropogonis* in Bull. Ala. Ag. Exp. Sta. **80**: 207, probably belongs here.

Diplodina quercuum (Cke.) Tracy & Earle

Hypophyllous, without spotting or discoloring the leaves: perithecia subsuperficial, solitary or gregarious, subconic, about 150 ×

100 μ, black: sporules elliptical, hyaline, uniseptate, not constricted, guttulate, 16–18 μ × 4–5 μ.

On living leaves of *Quercus Virginiana*, Ocean Springs, Miss., Feb., 1898, Tracy & Earle, no. 5253.

This seems to be *Sphaerellopsis quercuum* Cke. Grev. **12**: 23 and *Ascochyta quercuum* (Cke.) Sacc. Syll. Fung. **3**: 393, as nearly as can be determined from the brief and unsatisfactory description.

Coniosporium palmicola

Epiphyllous: acervuli abundant, scattered, subrotund, .5–.75 mm. in diameter, permanently covered by the epidermis which finally splits along one or both sides: sporules globose, opaque, minutely roughened, 11–13 μ.

On languishing leaves of *Sabal serrulata*, Biloxi, Miss., 1898, S. M. Tracy, no. 5243.

Cercospora Decumariae

Epiphyllous, occupying deadened areas at the apical end of the leaf, diffused: hyphae fasciculate in large clusters from a tuberculate base, short, simple, continuous, fuscous, 15–20 × 5–6 μ: conidia narrowly obclavate, much attenuated below, slightly fuscous, the enlarged upper part 5–7-septate, the attenuate lower portion continuous, 70–80 μ × 4–5 μ.

On languishing leaves of *Decumaria barbara*, Ocean Springs, Miss., Nov., 1897, S. M. Tracy, no. 5206.

Cercospora Morongiae

Caulicolous: spots definite, dark colored, oval, 3–5 mm. long: hyphae in dense clusters, simple or rarely branched, frequently septate, somewhat torulose, fuscous, 75–100 μ × 4–5 μ: conidia obclavate, fuscous, 3–5-septate, 50–60 μ × 3–4 μ.

On stems of *Morongia uncinata*, Ocean Springs, Miss., Apr., 1898, S. M. Tracy, no. 5205.

Cercospora Oxydendri

Hypophyllous on brown and deadened spots sometimes reaching 1 cm.: hyphae in small clusters, simple or branched, nodulose, several-septate, slightly fuscous, 20–25 μ × 5–6 μ: conidia slender, curved, nearly hyaline, 4–7-septate, 50–60 μ × 3 μ.

On languishing leaves of *Oxydendron arboreum*, Biloxi, Miss., Oct., 1898, S. M. Tracy, no. 4086.

Studies in Sisyrinchium—V: Two new eastern Species

By Eugene P. Bicknell

Up to the present time four species of *Sisyrinchium* have been recognized in the flora of the eastern coastwise states from New Jersey northward. These are *S. angustifolium* Miller, the commonest species of New York and New England and the only one ranging far northward and eastward through Maine to the provinces; *S. graminoides*, extending from east Massachusetts far southward and westward; *S. Atlanticum*, abundant along the coast from Massachusetts southward and occasionally found inland, as at Stratton, Vermont (A. J. Grout) and Concord, New Hampshire (W. W. Eggleston), and *S. mucronatum* Michx., common in the Alleghany region of east Pennsylvania and extending to central New York but as yet not reported east of the Delaware River.

To these four species two others must now be added, one a coastwise plant of New York and New Jersey, the other occuring from southern New Jersey southward. These new species are here described.

Sisyrinchium arenicola

Closely caespitose in stiff erect tufts 20–40 cm. tall from short woody rootstocks, the tufts coarsely brown-fibrous at base, the fibrous roots numerous, long and slender, becoming nearly black: stems and leaves rather bright green, sometimes glaucescent, readily discoloring to brown or black in drying, the spathes and often the stems and leaves purplish-tinged: leaves usually over half the height of the stem, stiff and erect, often slightly curved, .5–3 mm. wide, cuspidate-attenuate, strongly close-striate, minutely cellular-puncticulate between the nerves, the edges denticulate-serrulate to smooth: stem erect but often forming a shallow double curve, sometimes spirally twisted, 1–3 mm. wide, the distinct wings firm, striate, denticulate-serrulate or smooth; bracteal leaf conspicuous, erect, continuing the line of the stem, often slightly incurved, attenuate-acute, usually subequal with the peduncles, the rather broad compressed base strongly striate and oppositely bicarinate; peduncles 2–4, suberect or somewhat outcurved, in their early development appearing lateral from the stem, approximate or, when only two, the outer one often divergent, somewhat unequal, very short or elongated, 3–12 cm. long, stiff, wing-margined and serrulate, mostly 1 mm. or more wide (.5–2 mm.): spathes erect, the mostly cuspidate-acuminate bracts striate with delicate raised nerves, slightly unequal or the outer one slenderly prolonged for as much as 2 cm. when, as not infrequently occurs, the stem is simple; interior scales brownish-tinged, becoming over ¾ the length of the inner bract: flowers deep violet-blue, often numerous, 3–12, on nearly erect, slightly exserted pedicels 15–22 mm. long, which become somewhat spreading above in fruit; perianth 8–10 mm. long; stamineal column 4–5 mm. high, anthers small, bright orange-yellow; capsules dark and thick-walled, subglobose to obovoid, 3–5 mm. high: seeds black, globose, 1–1.5 mm. in diameter, distinctly pitted and with a rather prominent umbilicus.

In sand or sandy soil near the coast, Long Island to New Jersey, flowering from June till August, the fruit sometimes persisting till October.

New Jersey: Point Pleasant, Ocean Co., July 17, 1882, E. H. Day: Monmouth Co., Oct. 2, 1886, N. L. Britton.

New York: Staten Island, Todt Hill, June 12, 1887, and Tottenville, Aug. 3, 1890, N. L. Britton; Long Island, Southampton, June, 1898, W. N. Clute; Hempstead, June 30, 1899, Miss Fanny A. Mulford; Sag Harbor, July 20, 1899, still in flower, N. L. Britton; Amagansett, Aug. 7, 1899, Miss E. Babcock.

The specimens cited are contained in the herbaria of Columbia University and the New York Botanical Garden and in my private collection.

An interesting and unexpected addition to our eastern coast flora, of very restricted range, so far as yet appears, but in all probability extending further south than New Jersey and eastward to the New England coast.*

The species is a perfectly distinct one and though appearing intervenient with *S. graminoides* and *S. Atlanticum* is in closer relationship with a group of more southern species, including *S. xerophyllum* Greene and *S. rufipes*, characterized by a dense fibrous coating about the base of the tufts. In the possession of this character *S. arenicola* differs notably from all other species of the northern states except *S. Farwellii*, a very different species in other respects.

On herbarium sheets specimens sometimes show fully as much discoloration as *S. graminoides* and might be easily passed over for that species, but a moment's attention will discover that the plant is more caespitose and stiffer in habit than *S. graminoides* with narrower and more attenuate leaves which are thicker and more strongly striate; other evident differences are shorter, frequently clustered peduncles, stiffer and more striate bracts, more numerous flowers and smaller capsules on less exserted and spreading pedicels.

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* Mr. Bicknell writes, under the date of September 14, that he finds *S. arenicola* the common species on Nantucket Island.—Ed.

As compared with *S. Atlanticum*, *S. arenicola* is stouter and stiffer, never developing a flexuous prolongation of the stem from a lower node, and having much less membranous bracts which are decidedly more striate-nerved and acuminate, also the capsules are relatively more subglobose and the seeds larger. Perhaps the most evident feature of contrast between the two plants is in color, the rather deep green of *S. arenicola* producing a very different general effect from the very pale glaucous-green of *S. Atlanticum.*

It should also be noted that the flowering period of *S. arenicola* is considerably later than that of *S. Atlanticum* or *S. graminoides.*

Sisyrinchium intermedium

Dull green, sometimes not even glaucescent, turning dark in drying, the spathes purple or occasionally green: tufts not fibrous at base, 15–35 cm. high, the stems often numerous, the clustered roots numerous and slender: leaves erect, about half the height of the tufts, 1.5–2.5 mm. wide, attenuate and cuspidate-acute, thin and grass-like, the delicate nerves usually with a fainter alternating series, the tissue between minutely cellular-puncticulate, the edges minutely serrulate or even subciliolate-serrulate to smooth; young leaves sometimes roughened on the sides with minute points: stems very straight, frail, mostly 1.5 mm. wide (1–2.5 mm.), the thin wings with closely fine-serrulate edges and nerved like the leaves, usually much broader than the very narrow raised line of the proper stem; stems in some tufts all or nearly all simple, in others mostly forked at the top into two or even three pedunculate spathes subtended by a rather longer erect bracted leaf; peduncles 3–7 cm. long, often roughened on the sides with minute points, the outer one somewhat divergently outcurved, usually slender but distinctly winged, the wings serrulate, gradually widened into the base of the spathe: spathes narrow, sometimes not wider than the stem, erect, flattened and rather sharply two-edged, the sides narrowed to the base and margined below by the ascending wings of the stem; bracts thin, glabrous, delicately nerved, the outer one on simple stems prolonged beyond the inner 8–40 mm. and sometimes three times its length, in pedunculate spathes often but little prolonged, 2–6 cm. long, obscurely or very narrowly hyaline-margined, the edges not united below; inner bract narrow, 15–20 mm. long, narrowly hyaline-margined, mostly attenuate and cuspidate-acute, rarely scarious-obtuse and mucronulate; interior scales acuminate, brownish-tinged, about ⅔ the length of the inner bract: flowers 5–6, pale blue; perianth 8–14 mm. long; stamineal-column 4–5 mm. high: capsules on slenderly exserted and flexuously spreading pedicels 17–25 mm. in length, brown, broadly subglobose, or obovoid, 4 mm. high.

Southern New Jersey to North Carolina, flowering in May and early June.

New Jersey: Gloucester Co., June 1, 1892, B. Heritage, Herb. Phil. Bot. Club.

Pennsylvania: Philadelphia, A. B. Monoy, Herb. Mo. Bot. Gard.

District of Columbia: W. M. Canby, U. S. Nat. Herb.

North Carolina: Buncombe Co., Thos. Hogg, May, 1886, Herb. Columbia Univ.; G. McCarthy, May, 1888, U. S. Nat. Herb.; May 8, 1897, Biltmore Herb.; Wake Co., May, 1896, W. W. Ashe, Herb. W. W. A.; Henderson Co., Mrs. Schoolbred, 1857, Herb. N. Y. Bot. Gard.; also two sheets without record in Herb. Mo. Bot. Gard., one "ex herb. Bernhardi."

A perplexing plant appearing about intermediate between *S. graminoides* and *S. mucronatum*, yet not to be correlated with either one, although in its most divergent forms, showing a near approach to both. The more branched forms, which are nearest to *S. graminoides* differ in narrower and more attenuate leaves and purple spathes, and usually also develop many simple stems bearing spathes with much prolonged outer bracts; the branches when present are mostly shorter and more slender than in *S. graminoides* and, like the younger leaves, may be roughened on the sides; the margins of the stem and leaves are also usually more definitely serrulate than in *S. graminoides*.

The opposite form in which the stems may be all simple closely simulates *S. mucronatum* but dries dark and has thinner, more broadly winged stem and larger darker capsules on flexuously spreading pedicels as in *S. graminoides*.

A Synopsis of the Proceedings of the Botanical Organizations meeting at Columbus, Ohio, August 17–25, 1899

THE BOTANICAL SOCIETY OF AMERICA

The fifth annual meeting was held at Columbus, August 18 and 19, Dr. L. M. Underwood presiding.

In the absence of the Secretary, Prof. G. F. Atkinson, Dr. Arthur Hollick was made Secretary *pro tem.*

The following new members were elected: J. M. Macoun, Geological Survey of Canada; W. J. Beal, Michigan Agricultural College; C. F. Millspaugh, Field Columbian Museum; Marshall A. Howe, Columbia University.

The retiring President, Dr. N. L. Britton, delivered an address entitled: "Report of Progress of the Development of the New York Botanical Garden."

The following papers were presented:

1. Apetaly and Dioeciousness. By C. E. Bessey.
2. The Spore Mother Cells of *Anthoceros.* By Dr. B. M. Davis.
3. Symbiosis and Saprophytism. By Dr. D. T. MacDougal.
4. The effect of Centrifugal Force upon the Cell. By Dr. D. M. Mottier.
5. The American Species of *Arisaema.* By Dr. N. L. Britton.
6. The Uredineae Occurring upon *Phragmites*, *Spartina* and *Arundinaria* in America. By Prof. J. C. Arthur (read by title).
7. Some notes upon the Distribution of American Erysiphaceae. By Prof. B. D. Halsted (read by title).
8. Gametes and Gametangia of the Phycomycetes. By Dr. B. M. Davis (read by title).
9. Etiolative Reactions. By Dr. T. MacDougal (read by title).
10. The Foundation of Genera among the Ferns. By Prof. L. M. Underwood (read by title).
11. The Classification of Botanical Publications. By Prof. Wm. Trelease.

The following officers were elected for the coming year: President, Dr. B. L. Robinson; Vice-President, Prof. B. D. Halsted; Secretary, Prof. G. F. Atkinson; Treasurer, Dr. Arthur Hollick; Councillors, Prof. D. P. Penhallow and Prof. B. T. Galloway.

TITLES OF PAPERS READ BEFORE THE SECTION OF BOTANY, A.A.A.S., COLUMBUS MEETING

C. R. Barnes, Chicago, Vice-President; W. A. Kellerman, Columbus, Secretary. Address by Vice-President Barnes, subject: "The Progress and Development of Plant Physiology." The following papers were then presented:

1. The Fertilization of *Albugo Bliti.* By F. L. Stevens, Chicago, Ill.
2. The Embryo Sac of *Leucocrinum montanum.* By Francis Ramaley, Boulder, Col.
3. Notes on subterranean Organs. By A. S. Hitchcock, Manhattan, Kans.
4. Some Monstrosities in Spikelets of *Eragrostis* and *Setaria* with their Meaning. By W. J. Beal, Agricultural College, Mich.
5. Studies of Vegetation of the high Nebraska Plains. By Charles Edwin Bessey, Lincoln, Neb.
6. The Tamarack Swamp in Ohio. By A. D. Selby, Wooster, Ohio.
7. The Breeding of Apples for the Northwest Plains. By William Saunders, Experimental Farms, Ottawa, Canada.
8. Field Experiments with 'Nitragin' and other Germ Fertilizers. By Byron D. Halsted, New Brunswick, N. J.
9. The Duration of bacterial Existence under trial Environments. By Henry L. Bolley, Agricultural College, N. D.
10. Suggestions for a more satisfactory Classification of the pleurocarpous Mosses. By A. J. Grout, Brooklyn, N. Y.
11. Notes concerning the Study of Lichen Distribution in the Mississippi Valley. By Bruce Fink, Fayette, Iowa.
12. Botanical Teaching in the secondary Schools. By W. C. Stevens, Lawrence, Kansas.
13. Botanical Teaching in the secondary Schools. By Ida Clendenin, Brooklyn Girls' High School.
14. On the Occurrence of the Black Rot of Cabbage in Europe. By H. A. Harding, Geneva, N. Y.

15. One Thousand Miles for a Fern. By Charles E. Bessey, Lincoln, Neb.

16. A Summary of our Knowledge of the Fig, with Illustrations. By Walter T. Swingle, Washington, D. C.

17. The Classification of botanical Publications. By Wm. Trelease, St. Louis, Mo.

18. The Geotropism of the Hypocotyl of Cucurbits. By Edwin Bingham Copeland, Chico, Cal.

19. The Destruction of Chlorophyll by oxidizing Enzymes. By A. F. Woods, Washington, D. C.

20. The Effect of Hydrocyanic Acid Gas upon the Germination of Seeds. By C. O. Townsend, College Park, Md.

21. Some physiological Effects of Hydrocyanic Acid Gas upon Plants. By W. G. Johnson, College Park, Md.

22. Etiolative Reactions of *Sarracenia* and *Oxalis*. By Wm. B. Stewart, Minneapolis, Minn.

23. The Mycorhiza of *Tipularia*. By Julia B. Clifford, Minneapolis, Minn.

24. The Cultures of Uredineae in 1899. By J. C. Arthur, Lafayette, Ind.

25. The Embryology of *Vaillantia hispida*. By Francis E. Lloyd, Teachers College, Columbia University, N. Y. City.

26. Division of the megaspore of *Erythronium*. By J. H. Schaffner, Columbus, Ohio.

27. The Flora of Franklin County, Ohio. By A. D. Selby, Wooster, Ohio.

28. The fungous Infestations of agricultural Soils in the United States. By Erwin F. Smith, Washington, D. C.

29. Are the Trees advancing or retreating upon the Nebraska Plains? By C. E. Bessey, Lincoln, Neb.

30. Useful Trees and Shrubs for the Northwest Plains of Canada. By Wm. Saunders, Ottawa, Canada.

31. The Occurrence of Calcium Oxalate and Lignin during the Differentiation of the Buds of *Prunus Americana*. By H. L. Bolley and L. R. Waldron, Agricultural College, North Dakota.

32. Two Diseases of *Juniperus*. By Hermann von Schrenk, St. Louis, Mo.

33. The Crystals in *Datura Stramonium* L. By Henry Kraemer, Philadelphia, Pa.

For the coming year, Wm. Trelease was elected Vice-President and Chairman of Section G; D. T. MacDougal, Secretary.

BOTANICAL CLUB OF THE A. A. A. S.

Byron D. Halsted, President; F. H. Knowlton, Vice-President; A. D. Selby, Secretary *pro tem.*, in the absence of Stewardson Brown, Secretary.

The following papers were read:

1. A Greasewood Compass Plant. By C. E. Bessey.

2. A Visit to the original Station of the Rydberg Cottonwood. By C. E. Bessey.

3. Report of the Expedition to Porto Rico from the New York Botanical Garden. By N. L. Britton.

4. The Arboretum and Botanical Garden of the Central Experimental Farm at Ottawa, established in 1889. By Wm. Saunders.

5. Tomato Fruit Rot. By F. S. Earle.

6. Two hitherto confused species of *Lycopodium*. By Francis E. Lloyd.

7. Some of the Investigations on Grasses and Forage Plants in charge of the Division of Agrostology, U. S. Dept. of Agriculture. By Thos. A. Williams.

8. The Wilting of *Cleome integrifolia*. By C. E. Bessey.

9. The Powdery Mildew of *Polygonum aviculare*. By C. E. Bessey.

10. Notes on the northern Species of *Celtis*. By N. L. Britton.

11. Remarks on some Species of *Quercus*. By N. L. Britton

12. Ohio Stations for Lea's Oak. By W. A. Kellerman.

13. Labels for living Plants. By W. A. Kellerman.

14. The introduced Species of *Lactuca* in Ohio. By A. D. Selby.

15. Some Peculiarities of the yearly Reappearance of *Plasmopara Cubensis* B. E C. on Cucumbers and Melons. By A. D. Selby.

16. What shall we regard as generic Types? By L. M. Underwood.

17. A Brief embryological Study of *Lactuca Scariola*. By J. W. T. Duvel.

18. The Position of the Fungi in the Plant System. By H. L. Bolley.

19. Some botanical Notes by an Entomologist. By A. D. Hopkins.

20. A Device for registering Plant-growth. By L. C. Corbett.

21. Notes on some of the Work of the Division of Botany of the United States Department of Agriculture. By O. F. Cook.

22. The Botanical Club organized by the Students and Teachers of the Michigan Agricultural College. By W. J. Beal.

23. Introduction and Persistence of *Cabomba Caroliniana* on the Grounds of the Michigan Agricultural College. By W. J. Beal.

24. Distribution of certain Swamp Plants in Kansas. By A. S. Hitchcock.

The following officers were elected: President, F. S. Earle, Auburn, Ala.; Vice-President, A. D. Selby, Wooster, Ohio; Secretary, F. E. Lloyd, New York City.

SULLIVANT DAY

Wednesday, August 23d, was taken for a bryological memorial to do honor to Sullivant and Lesquereux. Relatives and friends of these distinguished bryologists were present and portraits of both were loaned for exhibition. The tribute to Sullivant written by Dr. Gray for the Supplement to the Icones Muscorum was read by Professor Kellerman. Twelve North American mosses named for Sullivant were loaned from the Sullivant collection at Harvard, with the original drawings. Duplicates of these species from the Columbia University collection were also mounted for exhibition as well as microscopic slides of them made by Mrs. Britton, who gave a brief account of their subsequent history. Dr. Charles R. Barnes read his tribute to Lesquereux from the *Botanical Gazette*, and Dr. Arthur Hollick supplied information on the posthumous publication of his palaentological work. Mrs. Britton gave a chronological record of the study of North American mosses since 1850, illustrated by tables and exhibited pamphlets and books which have been published since Lesquereux and James' Manual in 1884. Portraits of botanists whose names are perpetuated in those of American mosses were shown by E. A.

Rau, E. G. Britton and L. M. Underwood. Professor Kellerman exhibited a collection of mosses and drawings which had formerly been the property of Mr. Schrader, who made the drawings for Sullivant's Icones. Professor Underwood gave a brief account of the study of the Hepaticae, illustrated by books and pamphlets. The plates and specimens illustrating ten new species of hepatics from California, described by Marshall A. Howe, were exhibited by Professor F. E. Lloyd, who commended the morphological value of Dr. Howe's work.

Professor F. S. Earle read some notes on the moss flora of Alabama by Dr. Charles Mohr. Dr. A. J. Grout sent a set of the *Bryologist* and his revisions of the pleurocarpous mosses with some suggestions for a more satisfactory classification of them which were read by Mrs. Britton. Dr. George N. Best sent a set of his publications and Dr. Barnes exhibited a set of those of Renauld and Cardot and of Röll. Reports were received from the Sullivant Moss Chapter with a list of members from the Secretary, Mrs. Annie Morrill Smith. The Philadelphia Moss Chapter also sent a report and lists of books and specimens available for study at the Academy of Natural Sciences.

Among the specimens exhibited were several rare plants of Ohio, *Sullivantia Ohionis*, *Lonicera Sullivantii*, *Solidago Ohionis* and *S. Riddellii*, duplicates of which were distributed to all botanists present who cared to have them.

At the conclusion of the exercises Dr. C. E. Bessey offered a resolution advocating the founding of a bryological scholarship in memory of William S. Sullivant, and the resolution was accepted unanimously by those present.

Index to recent Literature relating to American Botany

Anderson, A. P. Rice Blast and a new Smut on the Rice Plant. Preliminary Report on Treatment for Rice Smut. Bull. S. C. Agric. Exper. Sta. 41: 1–31. Mr. 1899.

Andreas, J. Ueber den Bau der Wand und die Oeffnungsweise des Lebermoossporogons. Flora, **86**: 161–213. *f. 1–29. pl. 12.* 1899.

Atkinson, G. F. Studies on Reduction in Plants. Bot. Gaz. **28**: 1–26. *pl. 1–6.* 29 Jl. 1899.

Barnhart, J. H. Nomenclatural Notes.—II. Bull. Torr. Bot. Club, **26**: 376–380. 18 Jl. 1899.

Ilysanthes dubia (L.) and *Wulfenia Bullii* (Eaton), nom. nov.; notes on species in various genera, on dates of publication, etc.

Bicknell, E. P. Studies in *Sisyrinchium.*—II: Four new species from Michigan. Bull. Torr. Bot. Club, **26**: 297–300. 17 Je. 1899.

Sisyrinchium hastile, S Farwellii, S. strictum and *S. apiculatum*, sp. nov.

Bicknell, E. P. Studies in *Sisyrinchium.*—III: *S. angustifolium* and some related species new and old. Bull. Torr. Bot. Club, **26**: 335–349. 18 Jl. 1899.

Sisyrinchium campestre, S. campestre Kansanum, S flaviflorum and *S. heterocarpum* are proposed by the author as new.

Brandegee, T. S. Island Flora Notes. Erythea, **7**: 70–71. 1 Jl. 1899.

Hemizonia Clementina sp. nov.

Clute, W. N. On the Distribution of some eastern Ferns. Linnaean Fern Chapter (Boston Meeting), 14–18. 1899.

Coulter, J. M. The Origin of the leafy Sporophyte. Bot. Gaz. **28**: 46–59. 29 Jl. 1899.

Daguillon, A. Observations morphologiques sur les feuilles des Cupressinées. Rev. Gen. de Bot. **11**: 168–204. *f. 1–41. pl. 5.* 15 My. 1899.

Davenport, G. E. Abnormal Forms and Hybridity in Ferns. Linnaean Fern Chapter (Boston Meeting), 1–11. 1899.

Davenport, G. E. *Acrostichum lomarioides* Jenman. Bull. Torr. Bot. Club, **26**: 318–319. 17 Je. 1899.

De Boissieu, H. Quelques mots sur les *Mitella.* Bull. Mens. Soc. Linn. de Paris, **13**: 105–109. 10 My. 1899.

Eastwood, A. New Localities for rare Californian Plants. Erythea, **7**: 76–77. 1 Au. 1899.

Eaton, A. A. Notes on a peculiar *Botrychium.* Linnaean Fern Chapter (Boston Meeting), 25–30. 1899.

Farlow, W. G. Three undescribed Californian Algae. Erythea, **7**: 73–76. 1 Au. 1899.

Dictyopteris zonarioides, Spermothamnion Snyderae and *Polyopes Bushiae* sp. nov.

Fletcher, J. Botanical Notes. Ottawa Naturalist, **13**: 75–76. Je. 1899.

Gilbert, B. D. On the Genera of Ferns: A Study of the Tribe Aspidieae. Linnaean Fern Chapter (Boston Meeting), 19–25. 1899.

Gilbert, B. D. Two new *Polypodia* from New Zealand. Bull. Torr. Bot. Club, **26**: 316–317. 17 Je. 1899.

Polypodium viride and *P. vulgare auritum* are proposed as new.

Grout, A. J. An interesting Variety of *Osmunda Claytoniana.* Linnaean Fern Chapter (Boston Meeting), 11–12. 1899.

Grout, A. J. A little-known Mildew of the Apple. Bull. Torr. Bot. Club, **26**: 373–375. *pl. 364.* 18 Jl. 1899.

Sphaerotheca mali (Duby) Burrill.

Halsted, B. D. The Influence of wet Weather upon parasitic Fungi. Bull. Torr. Bot. Club, **26**: 381–389. 18 Jl. 1899.

Harkness, H. W. Californian Hypogaeous Fungi. Proc. Cal. Acad. Sci. III. **1**: 241–292. *pl. 42–45.* 8 Jl. 1899.

New species in *Hymenogaster, Hydnangium, Octaviana, Hysterangium, Rhizopogon, Leucophleps* gen. nov., *Melanogaster, Hydnocystis, Genea, Balsamia, Hydnobolites, Hydnotrya, Pseudohydnotrya, Pachyphloeus, Myrmecocystis* gen. nov., *Geopora, Tuber, Piersonia* gen. nov., *Terfezia, Terfeziopsis* gen. nov., *Endogone, Sphaeria* and *Sporophaga* gen nov. with descriptions of 108 species new and old.

Harvey, F. L. Contributions to a Knowledge of the Myxogasters of Maine. Bull. Torr. Bot. Club, **26**: 320–324. 17 Je. 1899.

Heller, A. A. New and interesting Plants from Western North America. Bull. Torr. Bot. Club, **26**: 312–315. 17 Je. 1899.

Lepidium Idahoense, L. simile, Ptelea rhombifolia, Microsteris diffusa, Crepis atrabarba and *Grindelia Brownii*, sp. nov.

Hennings, P. *Xylariodiscus* nov. gen. und einige neue brasilianische Ascomycetes des E. Ule'schen Herbars. Hedwigia (Beiblatt), **38**: (63)–(65). 25 Ap. 1899.

New species in *Diplotheca, Claviceps, Stictophacidium, Erinella, Gorgoniceps* and *Ombrophila.*

Hennings, P. Neue von E. Ule in Brazilien gesammelte Ustilagineen und Uredineen. Hedwigia (Beiblatt), **38**: (65)–(71). 25 Ap. 1899.

New species in *Ustilago, Urocystis, Polysaccopsis* n. g., *Uromyces, Puccinia, Uredo* and *Aecidium.*

Hennings, P. Fungi chilenses a cl. Dr. F. Neger collecti. Hedwigia (Beiblatt), **38**: (71)–(73). 25 Ap. 1899.

New species in *Dimerosporium, Melanomma, Montagnella, Cenangium* and *Septoria.*

Hill, E. J. Notes on Plants of the Chicago District. Bull. Torr. Bot. Club, **26**: 303–311. 17 Je. 1899.

Holm, T. *Juncus repens* Michx.—A morphological and anatomical Study. Bull. Torr. Bot. Club, **26**: 359–364. *pl. 363.* 18 Jl. 1899.

Holm, T. The Seedlings of *Jatropha multifida* L. and *Persea gratissima* Gärtn. Bot. Gaz. **28**: 60–64. *f. 1–6.* 29 Jl. 1899.

Howe, M. A. The Hepaticae and Anthocerotes of California. Mem. Torr. Bot. Club, **7**: 1–208. *pl. 88–122.* 5 Au. 1899.

Riccia Americana, R. Campbelliana, Clevea hyalina Californica, Sphaerocarpus cristatus, Cephalozia divaricata scabra and *Blepharostoma arachnoideum* sp. et var. nov.

Jeffrey, E. C. The Development, Structure and Affinities of the Genus *Equisetum.* Mem. Boston Soc. Nat. Hist. **5**: 155–190. *pl. 26–30.* Ap. 1899.

Klebahn, H. Kulturversuche mit heteroecischen Rostpilzen. Zeitschr. für Pflanzenkranheiten. **9**: 88–99. *f. 3, 4.* 6 My. 1899.

Cultures of *Melampsora.*

Lamb, F. H. Root Suckers on the Douglas Fir. Bot. Gaz. **28**: 69–70. 29 Jl. 1899.

Lemmermann, E. Das Genus *Ophiocytium* Naegeli. Hedwigia, **38**: 20–38. *pl. 3, 4.* 28 F. 1899.

Lloyd, C. G. Mycological Notes. No. 3. 18–24. Cincinnati, O. Ap. 1899.

Notes on various species of fungi including *Bolbitius sordidus* sp. nov.

MacBride, T. H. Botany: How much and when? Pp. 1–11. 1899.

MacMillan, C. Observations on *Nereocystis.* Bull. Torr. Bot. Club, **26**: 273–296. *pl. 361, 362.* 17 Je. 1899.

Magnus, P. Ueber die Gattung *Uropyxis* Schroet. Ber. Deutsch. Bot. Ges. **17**: 112–120. *f. 1, 2.* 26 Ap. 1899.

Meehan, T. *Echinocactus setispinis.* Meehan's Monthly, **9**: 81–82. *pl. 6.* Je. 1899.

Meehan, T. *Bidens connata.* Meehan's Monthly, **9**: 97–98. *pl. 7.* Jl. 1899.

Meehan, T. Contributions to the Life History of Plants. No. XIII. Proc. Acad. Nat. Sci. Phila. 1899: 71–117. *f. 1–5.* 1899.

Various morphological and biological notes relating to a variety of plants.

Nelson, A. The western Species of *Aragallus*: Critical Notes and Novelties. Erythea, **7**: 57–64. 1 Je. 1899.

Contains descriptions of several new species and varieties and a few changes in nomenclature.

Nelson, A. New species in *Oreocarya* and its Allies. Erythea, **7**: 65–70. 1 Je. 1899.

Oreocarya caespitosa, O. flavoculata, O. flavoculata spatulata, O. affinis perennis, O. longiflora, Cryptanthe ramulosissima, C. muriculata montana and *Allocarya Hendersoni* are proposed as new.

Nelson, A. New Plants from Wyoming—IX. Bull. Torr. Bot. Club, **26**: 350–358. 18 Jl. 1899.

Ranunculus alpeophilus, Arenaria pinetorum, Cheiranthus aridus, Draba andina (Nutt.), *Arenaria verna equicaulis, Polemonium Haydeni, P. mellitum* (Gray), *Pentstemon Crandallii, P. Coloradoensis, Grindelia perennis, G. erecta* and *Gnaphalium angustifolium*, new species, varieties, and names; *Nacrea*, gen. nov. with one species, *N. lanata* A. Nelson.

Nelson, E. Revision of the western North American Phloxes. Pp. 1–35. 1 Je. 1899.

Includes *P. Covillei, P. Piperi, P. cernua, P. virida, P. viscida, P. tenuifolia, P. hirsuta, P. lanceolata, P. aspera* sp. nov. and several varieties raised to specific rank.

Němec, B. Ueber Zellkern and Zelltheilung bei *Solanum tuberosum*. Flora, **86**: 214–227. *pl. 13, 14.* 20 My. 1899.

Osterhout, G. E. Notes on Colorado Plants. Erythea, **7**: 71–72. 1 Jl. 1899.

Peckholt, T. Medicinal Plants of Brazil. Pharmaceutical Archives, **2**: 92–100. My. 1899.

Peirce, G. J. The Nature of the Association of Alga and Fungus in Lichens. Proc. Cal. Acad. Sci. III. **1**: 207–240. *pl. 41.* 5 Je. 1899.

Pollard, C. L. The Genus *Achillea* in North America. Bull. Torr. Bot. Club, **26**: 365–372. 18 Jl. 1899.

Achillea Californica, A. gigantea and *A. Pecten-Veneris*, sp. nov.

Radais, M. On the Blight of Sorghum. Bot. Gaz. **28**: 65–68. 29 Jl. 1899.

Robertson, C. Flowers and Insects.—XIX. Bot. Gaz. **28**: 27–45. 29 Jl. 1899.

Roth, G. Übersicht über die Familie der Hypnaceen. Hedwigia (Beiblatt), **38**: (3)–(8). 28 F. 1899.

Rothrock, J. T. The Black Spruce (*Picea nigra* Link.). Forest Leaves, **7**: 40. Je. 1899. [Illust.]

Schrenk, H. von. A Disease of *Taxodium* known as Peckiness, also a similar Disease of *Libocedrus decurrens.* Rep. Mo. Bot. Gard. **11**: 1–55. *pl. 1–6.* 3 Je. 1899.

Schrenk, H. von. A sclerotioid Disease of Beech Roots. Rep. Mo. Bot. Gard. **10**: 61–70. *pl. 55, 56.* 1899.

Scribner, F. L. New Species of North American Grasses. Circ. U. S. Dept. Agric. (Div. Agrost.) **16**: 1–6. *f. 1.* 1 Jl. 1899.

New species in *Andropogon, Puccinellia, Poa, Dactyloctenium* and *Panicum.*

Scribner, F. L. Recent Additions to Systematic Agrostology. Circ. U. S. Dept. Agric. (Div. Agrost.) **15**: 1–10. *f. 1–5.* 14 Jl. 1899.

Selby, A. D., & Duvel, J. W. T. Sources of the Ohio Flora. Proc. Columbus Hort. Soc. **14**: 35–59. Mr. 1899.

Smith, J. G. The Velvet Bean (*Mucuna utilis*). Circ. U. S. Dept. Agric. (Div. Agrost.) **14**: 1–5. *f. 1–3.* 1899.

Smith, J. G. Grazing Problems in the Southwest and how to meet them. Bull. U. S. Dept. Agric. (Div. Agrost.), **16**: 1–47. *f. 1–9.* 1899.

Spegazzini, C. Nova Addenda ad Floram Patagonicam. Anales Soc. Cien. Argentina, **47**: 161–177. Ap. 1899.

Stone, G. E., & Smith, R. E. The Asparagus Rust in Massachusetts. Bull. Mass. Exp. Sta. **61**: 1–20. *pl. 1, 2.* Ap. 1899.

Sturtevant, E. L. Varieties of Corn. Bull. U. S. Dept. Agric. (Exp. Sta.) **57**: 1–108. 1899. [Illust.].

Vail, A. M. Notes on *Covillea* and *Fagonia.* Bull. Torr. Bot. Club, **26**: 301–302. 17 Je. 1899.

Covillea tridentata nom. nov. for *Zygophyllum tridentatum* Moç. & Sessé.

Williams, C. L. The Origin of the karyokinetic Spindle in *Passiflora coerulea* Linn. Proc. Cal. Acad. Sci. III. **1**: 189–206. *pl. 37–40.* 15 Ap. 1899.

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OCTOBER 1899

Symbiosis and Saprophytism

BY DANIEL TREMBLY MACDOUGAL

[PLATES 367–369]

GENERAL DISCUSSION

It is customary to designate all chlorophylless seed-forming species which have no nutritive connection with other vascular plants as saprophytes, or more exactly, holosaprophytes (allotropic or heterotropic forms according to Pfeffer's classification), and others of similar physiological tendencies as hemisaprophytes (mixotropic forms), without regard to the nutritive unions formed by the roots or absorbing organs in mycorhizas, tubercles and other associations. It is obvious that the term saprophyte, or holosaprophyte should be applied only to those species which derive their supply of food from organic products directly without the intervention of the activity of chlorophyll, and unaided by other organisms. In this sense, and it seems to the author to be the only meaning admissible, the holosaprophytes include numerous bacteria and fungi, but so far as present investigations show, only one seed-forming species, *Wullschlaegelia aphylla: Cephalanthera Oregana* was erroneously grouped in this class in a previous publication.*

---

* An abstract of this discussion of terms was read before the Society for Plant Physiology and Morphology, at New York, Dec. 28, 1898, and was published in American Naturalist, for March, 1899 (10). See also note on same in Science for Feb. 3, 1899, and Botanical Gazette for Feb. and Sept., 1899.

[Issued October 16.]

As a consequence of the above limitations all species furnished with mycorhizas, tubercles, or which enter into direct mechanical or nutritive associations must be classed as symbionts, or if it is desirable to maintain connection with existing literature dealing with these forms it would be permissible to refer to them as symbiotic saprophytes, although such designation must be regarded as tentative, and justified by expediency only (11).

It is a matter of common knowledge that seedlings are holosaprophytic in the stage in which they are wholly dependent upon the reserve material of the seed or fruit, and during the whole period previous to the formation of chlorophyll in general. This period is practically obliterated in those species in which chlorophyll is formed in the seed. On the other hand, the development of this tendency has been twofold. The increase of the capacity for the absorption of organic products has played an important part in the reduction of certain seeds to their present minute form, and again the retention, or extension, of this capacity throughout a greater or less portion of the life of the sporophyte has resulted in varying stages of true saprophytism, complete in one species of the higher plants only. The duration of the holosaprophytic stage shows very wide variations in different species. In certain arums it extends over two years under natural conditions, and may be extended by cultural methods so that the seedling may not form chlorophyll until the third or perhaps even the fourth year of existence, according to experiments now in progress. Only those species which show a marked capacity for the absorption and use of organic products during the greater part of the life of the sporophyte should be classed as hemisaprophytes. The hemisaprophytes would consist chiefly of the carnivorous plants. The greater majority of the species now included in this category are in fact more or less symbiotic by means of mycorhizas, tubercles or other nutritive associations.

This paper describes an extension of the investigations detailed in a previous paper (11), and an effort has been made to determine whether such associations constitute a single physiological type, or whether several types of nutritive adjustment are presented.

CEPHALANTHERA OREGANA Reichenb. (13)

A number of living specimens of this plant were examined in the field in Washington and Idaho in 1892, and alcoholic material from this region was obtained in 1899. Besides the notes and material thus obtained, the author has had the opportunity of inspecting herbarium material representing the entire known range of the species, from middle California northward into British Columbia, west of the main continental divide.

The plant consists of an upright subterranean rhizome 5 to 40 cm. in length, from the internodes of which arise the adventitious roots. The internodes are provided with short sheathing scales. The aërial stem is slender, waxy white, 20 to 50 cm. long, and bears short sheathing leaves which are wholly devoid of chlorophyll. The flowers form a dense terminal raceme and perhaps agree with those of other members of the genus in being self-fertilizing (Plate 367, Fig. 1).

The seedling has not been observed. The rhizome is perennial, and the stumps of two or three old aërial stems may be seen adhering to the most recently formed internodes. Although reported from open meadows by some collectors, the author has met it only in the deep humus of coniferous forests. Its deep penetration of the loose substratum, which is generally woven together by the interlacing roots of neighboring trees, makes the collection of the entire plant very difficult and as a consequence the greater number of herbarium specimens are lacking the root system, and on none of these has the writer found the mycorhizal rootlets described below.

THE ROOTS

The roots are wavy cylindrical organs 1.5 to 3 mm. in diameter, and from 5 to 12 cm. in length. One to four arise at each internode of the premorse rhizome, and penetrate the substratum at an angle of forty-five degrees with the horizontal. Mature organs have a yellowish-brown appearance due to the decay of the outer epidermal wall. A many-layered root-cap sheathes the tip for a distance of a millimeter, and shows a fairly normal structure. The epidermal cells are rectangular in surface section, with the radial walls separated to allow a slight outward convexity of the outer surface, which may in some instances assume a papillose form, or may be extended to form typical root-hairs. The latter, and all of the epidermal elements, are rich in protoplasm. The outer walls of the epidermis are covered more or less thickly with crystals of calcium. The sub-epidermal layer is hardly differentiated, and consists of muriform elements rich in protoplasm, and devoid of reserve material. The cortex is composed of ovoid, cylindrical or globose cells, the outer and inner layers of which are composed of elements slightly smaller than those of the middle region. The middle and inner regions are heavily loaded with starch, especially in the older or basal portions, and the cells of the middle region show a tendency to elongation in the radius of the root. Raphide cells are indifferently distributed throughout the cortical tissues, but perhaps more abundantly in the outer layers. Two types of roots which do not differ greatly in outward aspect may be distinguished; a fibrous form, and a fleshy form about twice the diameter of the first. External to the endodermis the two are similar except in the amount of development of the cortex. In the development of the thicker storage organs, the central parenchyma becomes slightly lignified and sclerotized, the xylem bundles increase from six to seven or eight, the pericycle shows two or three layers underneath the endodermis, and this sheath is composed of slightly thickened and pitted elements with no special passage cells. The xylem and the endodermis become lignified (Plate 369, Fig. 2). In the development of the fibrous roots the xylem undergoes such centripetal development, and lateral fusion that it changes from a hexarch to a tetrach. The heavily lignified xylem and the weakly developed central parenchyma form a four-rayed star, with the phloem lodged in the sinuses (Plate 369, Fig. 2). The endodermis is heavily thickened in the regions external to the phloem regions and consists of thin-walled passage cells opposite the xylem. The xylem shows great degeneration in both types of roots, and consists of scalariform vessels and elongated tracheids with transverse pits. The phloem exhibits no great deviation from the normal, and consists of narrow sieve tubes, companion cells and some parenchyma. A layer of elongated elements containing protoplasm and apparently adapted to the conduction of proteids lies immediately outside the phloem proper. The two types of roots show a remarkable resemblance in stelar alterations to those of the two types in *Wullschlaegelia aphylla* as described by Johow (7, p. 427), though not so distinctly separated by external characters.

The older roots often assume a dark-brown color over certain regions 6–10 cm. in length, due to the presence of an ectotropic fungus, which forms a *permanent mycelium* in three or four of the outer layers of the cortex (see page 523). The hyphae are heavy walled and septate. The inner branches form large vesicles which occupy the greater part of the cells of the medio-cortex. The outer branches of the mycelium pass through the short root-hairs into the soil. The region inhabited by the fungus gives rise to a few rootlets which assume the form of lozenge shaped branches with a length not greater than 3 cm. These branches arise endogenously, are brownish to within a few millimeters of the tips and are furnished with a well developed root cap. The mycorhizal fungus advances toward the tips as in the branches of the *Corallorhiza*, and the entire structure shows an arrangement generally similar to the coralloid branches of that plant.

In the half dozen perfect specimens in the hands of the writer the branches arise only from regions inhabited by the fungus and it is conjectured that the presence of this organism may act as a stimulant in setting up such action. The fungus is found in portions of the root-system 50 to 60 cm. below the surface of the soil, and as these organs are very brittle, especially the mycorhizal portions they are generally broken off in collection. The absence of chlorophyll and mycorhizas from numerous specimens sent in by the most careful collectors led the writer to announce that the

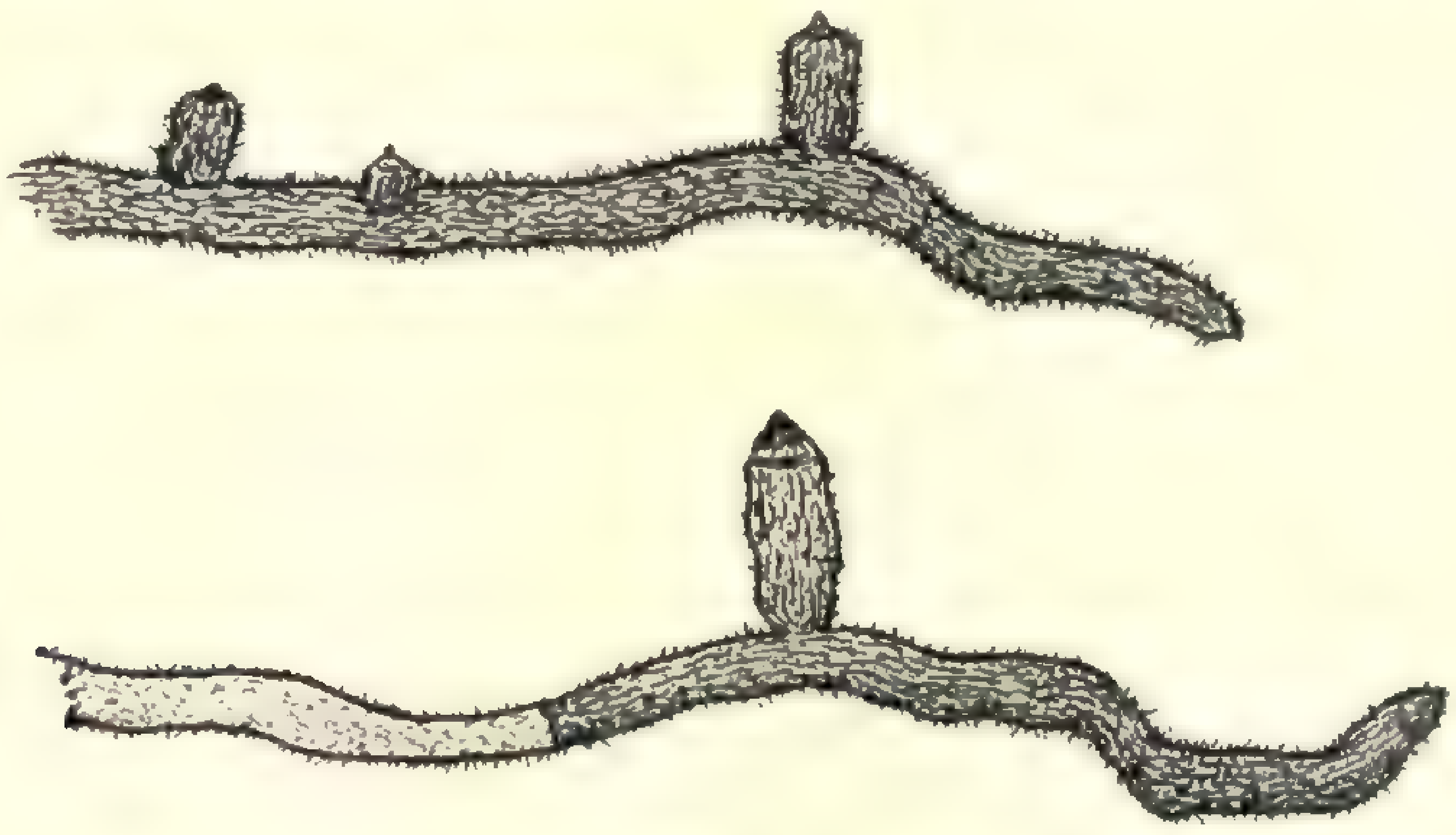

Fig. 1. Mycorhizal portions of roots of *Cephalanthera*.

species was a true saprophyte (11). Recently, however, Mr. O. D. Allen, of Ashford, Washington, by special request, dug up some entire specimens with the result that the mycorhizas were preserved, and are shown in Figure 1.

This species is noted as a parasite in systematic texts, but the author has failed to find any direct evidence of its nutritive connection with any other seed-forming species, either by his observations or from the reports of collectors.

The structural features of the roots agree with those of other mycorhizal forms in the reduction of the absorbing surfaces, the lack of spiral and annular vessels, the formation of tracheids with narrow transverse pits and the radial elongation of the mediocortical region. This last named feature has been supposed to be due to the influence of the fungus in mycorhizal roots, but Groom has shown that it may occur in portions of the root unoccupied by the symbiont. Its presence here, in portions of the root not occupied by the fungus, indicates that it is due to the necessities of absorption and use of organic food perhaps rather than to the stimulation of the presence of a symbiotic organism.

THE RHIZOME

The rhizome is an upright stem, slightly compressed, with internodes 1 to 2 cm. long, from the terminal internodes of which annually arise one or two flower scapes.

The epidermis is composed of elongated muriform elements with the outer walls slightly convex. No transpiratory openings are to be found. The cortex is ten to fifteen layers in thickness, the cells are ovoid, cylindrical, pitted and separated by spare intercellular spaces. The starch stored here during the resting season is usually exhausted in the formation of the inflorescence. The pericycle is two or three layers in thickness, heavily sclerotized and lignified and is interrupted in places by thin-walled elements. The crowded xylem ring contains a large number of scalariform ducts, and some imperfectly differentiated spiral and annular vessels, all deeply lignified. The phloem consists of cambiform elements with spare protoplasmic content. The interfascicular parenchyma shows collenchymatous thickenings in places, and numbers of elongated conducting cells with unlignified walls are placed near the vessels (Plate 369, Fig. 4).

The rhizome exhibits no marked or general degeneration, unless the condition of the phloem could be interpreted in this manner. The xylem is amply developed for the conduction of the supply of water necessary for the aërial shoot, and the elongated elements near the vessels appear to be suitable for the transmission for proteinaceous compounds, a function served by certain cells immediately internal to the endodermis in the root. The rhizome of *Cephalanthera* differs from similar members in symbiotic saprophytes in not being provided with organs for the excretion of water.

The Inflorescence

The flowering stem is composed of flattened internodes 2 to 5 cm. long, bearing short sheathing leaves, and a terminal raceme of flowers. The epidermis is composed of flattened cylindrical elements with oblique ends, resembling tracheids in general form, and with the inner and radial walls dotted with numerous perforations. Irregular masses, globules and networks of a yellowish brown substance are abundant in the epidermal and cortical cells of material preserved in alcohol. Ordinary chemical tests are without definite reaction, though Raspail's reagent gave slight indication of proteids in these masses. The epidermis is totally devoid of transpiratory openings.

The cortex is eight to twelve layers in thickness, and consists of elongated cylindrical elements with no intercellular spaces. It appears to serve as a tissue for the storage of water. Internal to the cortex is a sclerenchyma sheath, in the inner margin of which lies a circle of 32 to 40 bundles, and centrally placed is a second ring of six to eight bundles, which are fairly identical with those of the rhizome. Each bundle is enclosed in its own schlerenchyma sheath. The sheath and the xylem are heavily lignified. No marked degeneration is to be seen outside of the lack of chlorophyll, the transpiratory organs, and the intercellular spaces of the cortex. The heavy sclerenchyma sheath is a feature of the aërial stems of the symbiotic saprophytes. The xylem shows a very typical development.

The Leaves

The leaves are reduced to sheathing bracts, and are destitute of chlorophyll, as shown by an examination of the alcoholic extract with the micro-spectroscope. The free portion representing the lamina is 1 to 2 cm. in length, and the outer dorsal surface is provided with stomata, the guard cells of which are motile and contain starch (Plate 369, Fig. 5). The possibility that the guard cells may contain a small amount of chlorophyll is not excluded, though it could not be detected by ordinary tests in the specimens examined. The epidermis is composed of muriform cells with the outer walls convex and not cuticularized. The mesophyll consists of two layers of irregularly globoid elements rich in protoplasm, and separated by large air-spaces. A third layer of thin-walled elements, cylindrical in form are to be found lateral to the simple fibrovascular bundles. This tissue is devoid of protoplasm and may serve for the storage of water. The sclerenchyma sheath is incomplete at the point of contact with this supposed storage tissue, thus permitting the ready passage of water between the xylem and the thin-walled cells.

The degeneration of the leaf is seen to consist in the loss of chlorophyll, the lack of differentiation of the mesophyll, and the reduction of the surface. This degeneration has been accompanied by the development of a tissue for the storage of water, and by the retention of the stomata. *Cephalanthera* is to be added to the list of chlorophylless species furnished with motile stomata.

GENERAL CONSIDERATIONS

It is evident that the mycorhiza of *Cephalanthera* is to be considered as adventitious or accidental in its occurrence. In a large number of ectotropic forms the fungus gains entrance to the underground organ very early in its development, and then keeps pace with its growth. In this instance, however, it is found only in certain regions, and might be mistaken for a parasite were it not for its characteristic vesicles or organs of interchange. The comparatively small area of the mycorhizal structures suggests that *Cephalanthera* is capable of absorbing largely from the humous products independently.

CALYPSO BULBOSA (L.) Oakes

The author has called attention to the occurrence of adventitious mycorhiza in *Calypso* (11), and cited Lundström's description of these formations, which have been found by him and others in Europe and America. Since that paper was sent to the press a shipment of plants has been received, which had been collected in northwestern United States, and a number of the specimens showed the coralloid mycorhiza. A careful reëxamination has been made of these structures in the light of the generalizations drawn from previous material, and the results are presented below.

The subterranean stem of *Calypso* consists of an ovoid tapering corm 1.5 to 2 cm. in length, comprising two or three internodes. The single ovate, or ovate-cordate leaf is terminal, while the inflorescence arises from the first node below. The plant is reproduced vegetatively by a short offset of such reduced length that the new corm formed from its apical internodes stands upright in contact with the old corm (Plate 367, Fig. 6). The few short roots arising from the base of the corm are mycorhizal as described in the previous paper.

STEM-MYCORHIZA

The old or spent corms of the preceding season's activity may give rise to offsets from the basal internodes, and these may develop into coralloid structures by the repeated branching due to the development of all the buds, as in *Aplectrum*. The general anatomy of the coralloid formations is too nearly like that of the stem-mycorhizas of *Aplectrum* to warrant description here.

The fungus is seen to be a loose skein of hyphae in the three or four outer layers of the cortex passing outwardly through the thin-walled epidermal cells into the substratum, and do not, so far as observations go, traverse through the nodal trichomes. In this respect *Calypso* differs from other coralloid plants. Occasionally small globular or ovoid structures resembling sporangioles are to be found terminating the branches of the hyphae in the outer cortex. The three or four layers of the medio-cortex are filled with dense masses of interwoven hyphae. The hyphae form irregularly swollen branches upon entering the cells of this region, and one or two of these branches near the nucleus of the cortical cell expands into a vesicle, which in turn gives off a large number of branches nearly filling the cell. The hyphae are unseptate and have definite heavy walls. The form, irregular outlines and indefinite membranes of the hyphae in the medio-cortex led Lundström to believe that the fungus was plasmodial in its earlier stages (9). This appearance is heightened by the adhesion of the cytoplasm of the cortical cell to the hyphae. The inner cortex is free from hyphae, and contains starch in abundance, especially in the apical region. Starch is also present in the outer cortex, but quickly disappears from the cells invaded by the hyphae. The nuclei of the outer cortical cells are nearly normal, but those of the medio-cortex, occupied by the fungus, are hyperchromatic, distorted, and in some instances undergo fragmentation, as in *Peramium* (11). The stele is not differentiated into xylem and phloem, and consists chiefly of cylindrical elements rich in protoplasm, not differing greatly from plerome. The endodermis cannot be made out. The fungus of the coralloid structure and that of the roots are quite similar, but their identity is not established.

A comparison of the specimens which have come under inspection makes it apparent that the tendency to form coralloid mycorhizas may play as important a part in *Calypso* as in *Aplectrum.* The coralloid stems were small in some instances, and attached to the base of corms two years old, while in others their bulk was greater than that of the corm of the previous season to which they were attached. The extreme development was found in one specimen in which the coralloid structure was very large, and the old corm to which it was attached was shrunken to half its original size, but was still sound and normal (Plate 367, Fig. 8). A second offset had sprung from the node nearest the apex of the corm. This offset was about a centimeter in length and bore two roots at the first node while the three upper internodes had begun to swell in the formation of a new corm. The terminal portion bore a rounded cordate leaf and a flower bud. The members of this specimen named in order from the basal end were: stem-mycorhiza, spent corm, offset, roots, developing corm, flower bud and leaf. A comparison of the specimens at hand showed a fairly well established correspondence between variation in the outline of the leaf and the development of the stem-mycorhiza. Such variation might be due to the increased capacity of the plants furnished with coralloid structures for the absorption of humus products.

The variation in the leaf is also accompanied by increase in the length of the offsets, the decrease of the capacity of the storage organs, and the diminution in the number of the roots. The coralloid offsets of *Calypso* have not been seen to give rise to new plants as in *Aplectrum*.

The very great divergence of individuals from the type in leaf and flower characters in this species has been a subject of remark among systematists for many years, and Mr. Heller has recently raised one of the most pronounced forms to specific rank (4). Whether such variations of the shoot are directly correlated with the development of the mycorhizal structures or not can not be definitely stated. The matter may be determined only by the careful examination of specimens in the field throughout the habitat of the species.

Corallorhiza Arizonica Wats.

(No. 94 of collection of 1898 by MacDougal.)

The general morphology, and occurrence of the fungus of the coralloid branches of *Corallorhiza* have been somewhat fully described by Schacht, Irmisch, Reinke and others, chief attention having been paid to *Corallorhiza Corallorhiza* (L.) Karst (*C. innata*). The results at hand, however, were obtained quite early in the history of investigation upon this subject, and certain details now known to be of great interest were not touched upon in these earlier researches. It was deemed advisable, therefore, to make a reëxamination of the mycorhizal structures of another representative of the genus, with especial attention to the physiological relations of the members of the symbiotic union. Jennings and Hanna (6) have recently published a short paper on *C. innata* in which it is stated that the symbiotic fungus is a "hymenomycete and commonly an argaric." *Clitocybe infundibuliformis* Sch., was found attached to the coralloid formations in one instance, and "*Hysterangium stoloniferum of Tulasne*" in another in a manner indicative of the identity of these species with the symbiotic fungus.

Corallorhiza Arizonica is a native of the upper part of the transition zone and the Canadian zone in the Rocky Mountains. The subterranean portion of the plant consists of a dense mass of coralloid stems which lie as deep as 20 cm. below the surface, and from which extends upwardly a premorse rhizome 10 to 15 cm. in length. The thick aërial stem reaches a height of 15 to 25 cm., is sheathed by membranous leaves, and terminated by a strongly developed racemose inflorescence. The leaves and stem are irregularly colored with blotches of reddish, purplish and brownish tints, and appear to be wholly free from chlorophyll. Specimens with rudimentary aërial stems and others in bloom were collected by the writer on Mormon mountain, and on the San Francisco mountain in Arizona in 1891 and 1898, and preserved in alcohol. The results described below are based upon this material.

The coralloid mycorhiza

The mycorhiza of this plant is a dense mass of club-shaped branches arising from the upright underground rhizome, on which the true roots are to be seen as minute papillae. The germination of the seed has not been observed, and it is impossible to say whether the primary roots are developed or not, or at what stage the symbiotic fungus invades the offsets which constitute the coralloid mass. Reinke figures a young plant, probably of the second year's growth, in which the underground member consists of a coralloid stem only (14). The external anatomy and method of branching need no further description in this species. The rhizome attains a thickness of 4 to 6 mm., with internodes 2 to 4 mm. in length.

The phloem consists of two or three layers of prosenchymatous cells with yellowish thickened walls and slimy contents, most nearly like companion cells. The phloem forms two crescents with the tips nearly touching with the 3 to 5 xylem bundles lying internally, or the phloem may form a complete ring enclosing the xylem. The xylem consists almost entirely of scalariform vessels and one or two tracheids in which the perforations are oval and elongated obliquely. The central parenchyma is made up of short cylindrical cells often richly loaded with starch. The pericycle is present as one or two layers of cambiform cells, and the endodermis forms a sheath of flattened cylindrical elements. External to the stele is a cylinder of cortical tissue 10 to 15 layers in thickness composed of ovoid or globoid elements, with large intercellular spaces, and containing starch during the resting period. The medio-cortex is 15 to 20 layers in thickness and is composed of cells with the radial diameter twice the axial. The outer cortex consists of 3 to 5 layers of very thin-walled elements with the tangential diameter greater than the radial. Both the medio-cortex and the outer cortex are provided with intercellular spaces. The epidermis is composed of flattened cells, irregular in outline, with the lateral and inner walls pitted and the outer wall slightly thickened and brownish in color. It is furnished with a large number of stomata, with the motile guard cells of crescentic form (Plate 368, Figs. 5 and 6) containing starch. These and the large intercellular spaces constitute a very efficient aërating system, and makes the coralloid structure independent of the aërial shoot in transpiration, and at the same time allows free access of atmospheric oxygen. The apices of the rudimentary sheathing leaves are soon converted into a number of blackish shreds and their bases persist as wedge-shaped rudiments with no distinct function. Clumps of large trichomes resembling root-hairs arise from papillae which are infra-axillary to the leaves.

The fungus obtains access to the coralloid offset at quite an early stage of its existence and constantly grows toward the elongating apex forming convolutions of pale gray shining hyphae with numerous septae in the outer cortex. The growth of the hyphae keeps pace with the offset in its slow growth, and they extend forward to the shoulder of the blunt tip of each branch, curving inward at this place toward the embryonic tissue. The hyphae in the outer cortex remain active even in old mycorhiza and may be designated as forming the permanent mycelium. The permanent mycelium is thus in the shape of a sub-epidermal cylinder, and when new branches are formed the sheathing cylinder of the fungus is continued out in it. Branches from the apical portion of the permanent mycelium penetrate the medio-cortex while it is still in an undifferentiated condition, and these branches grow and ramify with the development of the cortical cells until the latter are almost filled with their dense convolutions. For some unknown reason the development of the hyphal branches is greatest immediately internal to the nodal trichomes in the medio-cortex. The hyphal branches are generally cylindrical but occasionally portions become swollen to twice the normal diameter, but no enlargements constituting sporangioles, vesicles or other organs of interchange are to be seen. The cortex of the younger portions of the coralloid structures is filled with starch granules which are slowly corroded by the action of the developing hyphae. Cells in which the hyphae have made many convolutions still contain some starch, but it finally disappears. The hyphae in the medio-cortex a distance from the tip are yellowish and collapsed, but no solid bodies are to be seen as a result of the liberation of their disintegration products in the cortical cells. The protoplasm of the latter is well spent but normal, and the nuclei are normal and active. The permanent mycelium sends out external branches through the trichomes into the soil. The permanent mycelium is, therefore, in the form of a sheathing cylinder with numbers of branches opposite each other extending out into the substratum and into the cortex. It is to be pointed out in this connection that the numerous statements to the effect that the fungus gains access to the interior of the coralloid structure through the trichomes are obviously incorrect. Entrance to the offset in the initial stage of the formation of the coralloid branches is perhaps made in this way, but once inside the branch the permanent mycelium is found which keeps pace with growth of the cortex and sends branches outwardly through the trichomes. The continued and repeated entrance of the fungus through the trichomes is an assumption only, and is based on the necessities of the theory of mycorhizas as fungus traps rather than on the actual facts.

The chemotropic reactions of the fungus as shown by its method of extension are of great interest. The permanent mycelium traverses the coralloid branches in the layers of cortical tissue first differentiated. The tips of the hyphal branches are attracted out through the trichomes, presumably by atmospheric oxygen, or by the humus products, which would increase in concentration from the base of the epidermal cells to the apices of the trichomes. The attraction of the branches into the medio-cortical cells must be due to a carbohydrate, rather than a nuclear product, since it is quite noticeable that all convolutions of the hyphae are made in regions of the cell some distance from the nucleus. The tip of a hypha may pass within its own diameter of the nucleus of the cortical cell with mutual indifference, and only in a small number of instances does the presence of the fungus affect the nucleus. Excretions from the hyphae cause some distortion of a few nuclei, which are also hyperchromatic. The hyphae may be traced around the cell in several circuits. Penetration of the wall and entrance into a neighboring cell is not made until the supply of starch is nearly exhausted, and the solution in the contiguous cell would form a stronger chemotropic stimulus. The portion of the hypha in the wall appears but half the normal diameter of the typical filament, and is nearly colorless even in old formations.

The ascending rhizome

The ascending rhizome consists of four or five napiform segments, each consisting of two or three internodes and representing one season's growth. As each segment is formed it gives rise to an inflorescence from an apical node. Later in the season it forms offsets which reproduce the premorse rhizomes with their coralloid branches. As a consequence of this mode of growth, a dozen plants may be found adherent in a colony, with the coralloid mycorhizas closely crowded in a huge clump.

The epidermis of the rhizome consists of very irregular elements, some of which contain starch at all times. Numerous hyathodes with a central oval or oblong central cell filled with a dense mass of yellowish brown secretion, surrounded by six or seven radially arranged elements are to be seen (Plate 368, Fig. 4). The cortex shows a very copious development, consisting of ovoid or globoid elements with ample air-spaces, and embracing a large number of mucilage cells. This member is therefore furnished with a very efficient mechanism for the extrusion of water: an important provision in an organ devoted to the condensation of carbohydrates of soluble carbohydrates to starch, and this process may continue irrespective of the presence of the aërial shoot. The pericycle forms a dense heavy ring of 7 to 10 layers rich in proteids. The stele in general exhibits a degree of degeneration corresponding with that of the coralloid branches. Its parenchymatous elements as well as the cortex are loaded with starch.

The Inflorescence axis

The epidermis consists of flattened cylindrical cells with oblique ends, are rich in protoplasm, and entirely devoid of stomatal openings. The 10 to 15 layers of cortical tissues are furnished with very large intercellular spaces, which may denote an epidermal transpiration of some importance, though no special adaptation for this purpose could be detected. Crystal cells are scattered throughout the cortex and appear even in the epidermis. The pericycle is composed of several layers of elongated cells with thickened walls and yellowish brown contents. The bundles are scattered in the stele with the xylem and phloem radially arranged. Their degeneration is fairly uniform with that of the rhizome and its branches. The leaves are sheathing, destitute of stomata, and show no differentiation of tissue for food-formation, or transpiration, except that the globular parenchyma shows great intercellular spaces. As noted above they are free from chlorophyll *C. Arizonica* differs from *C. Corallorhiza* (*C. innata*) in the formation of a bulky premorse rhizome furnished with stomata, the total lack of chlorophyll in the shoot, with absence of stomata, and in the greater degeneration of the stele. The differentiation of the fungal symbiont into a permanent mycelium with short-lived and external and internal branches seems to be a mycorhizal character described here for the first time, though it is present in *C. Corallorhiza* and other species. The hyphae in the coralloid formation of *C. Corallorhiza*, *C. multiflora* and others are applied to the nuclei in the cortical cell while in *C. Arizonica* this is not the case, indicating a difference of chemotropic reaction of the fungus in the two instances.

Relations of the mycorhizal components

The fungus in the coralloid formations of *Corallorhiza* draws its nourishment from two sources ; from the humus products of the soil and from the carbohydrates in the cortex. The material thus obtained is used in the construction of extensions of the mycelium and its branches. With the growth and progression of the mycorhiza, the older internal branches of the mycelium which have formed dense masses in the medio-cortex undergo disintegration and the products thus liberated may be drawn in two directions : toward the apex of the mycorhiza and toward the premorse rhizome. On arrival at both places the surplus material is converted into starch. The starch of the rhizome is used in the construction of the reproductive and other branches. The starch in the apex of the coralloid mycorhiza is used in the construction of embryonic tissue and a portion of it remains in the medio-cortex and becomes available to the fungus as a highly advantageous food.

Janse and others have upheld the theory that endotropic mycorhizas are similar in physiological value to leguminous tubercles (11), but the only actual proof adduced in favor of this view is the evidence obtained by Nobbe and Hiltner from experiments with *Podocarpus* (12). That endotropic fungi may coöperate in the fixation of free nitrogen in the roots of plants in which they occupy only a portion of the absorbing system is readily admissible and may be considered as proven. Such an explanation is wholly inadequate to account for the arrangement of the mycorhizal components and transpiratory structures in *Corallorhiza*, however, on purely anatomical grounds. The underground members of this genus are furnished with a complete sub-epidermal sheath of mycelium, which fills every cell of the outer cortex in two or three layers, except a minute area at the tip of the coralloid branch, and usually the 10 to 15 layers of the medio-cortex. It is obviously impossible for the *Corallorhiza* to absorb substances from the soil except through and by the agency of the fungus. The fungus may be capable of accomplishing the fixation of free nitrogen, but that it is not its sole, or its major function in the symbiosis, since all of the food-material of the association must pass through its hyphae; a statement equally true of such forms of ectotropic mycorhiza as those of *Pterospora*, *Monotropa*, etc. The higher plant affords a lodgment for the fungus, from which it sends out absorbent and reproductive branches. Food-material taken in by the fungus is yielded to the higher plant and constitutes its sole supply. To this extent the higher plant is parasitic upon the fungus. But the higher plant accomplishes transformations of chemical energy in the food thus obtained of which the fungus is incapable and yields the elaborated product in an advantageous form in the apex of the mycorhiza, where it serves as a food for the advancing mycelium. The higher plant is, therefore, not a fungus-trap pure and simple, as the association is of great mutual advantage.

The principal conclusions which may be drawn from the facts adduced in the foregoing paper may be briefly stated as follows:

I. The term saprophyte should be applied to those species only which derive their food-supply from organic products, unaided by chlorophyll, and without the intervention of other organisms. The true saprophytes therefore include numerous bacteria, fungi and but one seed-forming species—*Wullschlaegelia aphylla.* The saprophytic capacity of the seedling has been extended to cover periods of varying length in the life of the hemi-saprophytes and with symbiosis has reacted to diminish the tendency to store reserve material in seeds.

II. The degenerations of the true saprophytes are generally parallel to those of mycorhizal forms.

III. *Cephalanthera Oregana* and *Corallorhiza Arizonica* are to be added to the list of chlorophylless plants furnished with stomata.

IV. The offsets of *Calypso* are occasionally converted into coralloid mycorhizas as in *Aplectrum.* The stele of such structures is not differentiated into xylem and phloem. The occurrence of the coralloid mycorhiza is accompanied by variations in the form of the leaves, and of the decrease in the capacity of the storage organs in the specimens examined.

V. *Corallorhiza Arizonica* exhibits greater development of the symbiotic adaptation than *C. Corallorhiza.* The stele is quite primitive throughout, chlorophyll is lacking, and stomata are present on the coralloid branches only. The epidermis of the pre morse rhizome is furnished with hyathodes. The aërial shoot is furnished with large intercellular spaces, but may carry on epidermal transpiration only. The fungus in the coralloid structures consists of a permanent mycelium, with external and internal branches; the former are organs of absorption and reproduction, the latter are organs of interchange between the members of the symbiosis. The higher plant affords lodgment for the fungus and carries on chemical transformations the products of which are available to the fungus. The latter absorbs and yields to the higher plant in a more or less complex form the products of the humous soil.

VI. All endotropic mycorhizas do not conform to a single physiological type. The theory of Janse that endotropic fungi are negatively chemotropic to oxygen, and bear the same relation to the higher plant as the organism of the leguminous tubercle, is not capable of general application. Such relation has been proven between *Podocarpus* and the peronosporous fungus of its mycorhiza only.

VII. Two types of endotropic mycorhizas may be distinguished; one adapted for nitrogen fixation, and a second for the absorption and modification—perhaps oxidation—of the soil products before liberation in the tissues of the higher plant. The extension of information will doubtless result in the further division of the second type.

Literature to which Reference is made.

1. **Bonnier and Mangin:** Recherches sur la respiration des tissues sans chlorophyll. Ann. Sc. Nat. VI. **18**: 203. 1884.

2. **Engler u. Prantl:** Die naturl. Pflanzenf., **2**: 11. ——.

3. **Pfeffer:** Pflanzenphysiol. **1**: 349. 1897.

4. **Heller:** New plants from western North America. Bull. Torr. Bot. Club, **25**: No. 4. April, 1898.

5. **Janse:** Les endophytes radicants de quelques plantes javanaises. Ann. d. Jard. d. Buitenzorg. **14**: 53. 1896.

6. **Jennings and Hanna:** *Corallorhiza innata* R. Br. and its mycorhiza. Sc. Proc. Roy. Soc. Dublin, N. S. **9**: [pages ?]. 1899.

7. **Johow:** Die chlorophyllfreine Humusbewohner West Indiens, biologisch-morphologisch dargestellt. Pringsh. Jahrb. f. wiss. Bot. **16**: 445. 1885.

8. **Lory:** Sur la respiration et la structure des Orobanches, et autres plantes vasculaires deporvues de partes vertes. Ann. Sc. Nat. III. **8**: 158. 1847.

9. **Lundström:** Einige Beobachtung ueber *Calypso borealis*. Bot. Centralb. **38**: 697. 1889.

10. **MacDougal:** Symbiosis and Saprophytism. Am. Nat. **33**: 210. 1899.

11. **MacDougal:** Symbiotic saprophytism. Ann. Bot. **1**: 1. 1899.

12. **Nobbe u. Hiltner:** Die endotropische Mycorhiza von *Podocarpus*, und ihre physiologische Bedeutung. Landw. Versuchssta. **51**: 241. 1898.

13. **Reichenbach:** Orchidiographische Beitrage. Linnaea, **41**: 53. 1877.

14. **Reinke:** Zur Kenntniss des Rhizomes von *Corallorhiza* und *Epipogon*. Bot. Zeit. **56**: 145. 1873.

15. **Thomas:** The genus *Corallorhiza*. Bot. Gaz. **18**: 166. 1893.

Explanation of Plates

Plate 367. (1) Entire specimen of *Cephalanthera Oregana* Reichenb: *A*, base of aërial stem. (2) Premorse rhizome of *Corallorhiza Arizonica*: *A*, terminal bud; *B*, *B*, *B*, *B*, scars of preceding buds; *C* and *D*, offsets from which arise coralloid branches. (3, 4 and 5) Coralloid branches of *Corallorhiza Arizonica*. (6) Typical specimen of *Calypso borealis*: *A*, young corm; *B*, corm of previous season's formation. (7) Aberrant specimen of *Calypso*: *A*, old corm with coralloid branch. (8) Widely aberrant form of *Calypso*: *A*, young corm; *B*, old corm with large coralloid branch, *C*.

Plate 368. *Corallorhiza Arizonica* Wats. (1) Longitudinal section of tip of old coralloid mycorhiza: *a*, *a*, epidermis; *b*, *b*, medio-cortex, containing disintegrating branches of fungus; *c*, stele; *m*, *m*, permanent mycelium; *d*, *d*, branches; *e*, leaf. (2) Portion of transverse section of mycorhiza: *e*, epidermis; *c*, permanent mycelium; *m*, internal branches in medio-cortex; *p*, inner cortex; *b*, phloem; *o*, xylem. (3) Cells from cortex: *a*, *a*, hyphae of permanent mycelium; *c*, masses of hyphae in mediocortical cells; *n*, *n*, *n*, nuclei of cortical cells. (4) Hyathode from premorse rhizome. (5) Stomata from coralloid branch. (6) Section of epidermis of coralloid branch showing structure of stoma: *e*, *e*, epidermal cells; *a*, guard cells; *n*, nucleus. (7) Transverse section of aërial stem: *e*, epidermis; *c*, cortex; *d*, sclerenchyma sheath; *x*, *x*, fibrovascular bundles.

Plate 369. *Cephalanthera Oregana* Reichenb. (1) Transverse section of stele of storage root: *p*, medulla; *x*, *x*, xylem; *c*, endodermis. (2) Transverse section of stele of fibrous root: *v*, passage cells of endodermis; *e*, thickened cells of endodermis outside of phloem; *s*, phloem; *z*, xylem; *c*, medulla. (3) Longitudinal section in stele; *o*, *s*, vessels; *m*, medulla; *n*, endodermis. (4) Portion of transverse section of rhizome: *e*, epidermis; *h*, cortex; *f*, sclerenchyma sheath; *g*, fibrovascular bundles with heavy sheath; *r*, parenchyma. (5) Stoma from leaf.

A Revision of the North American Species of Scleropodium

By A. J. Grout

SCLEROPODIUM Br. & Sch. Bry. Eur. 1853

Closely allied to *Brachythecium* and included in it by some authors; differing slightly in the general habit and in the julaceous branches with concave, often obtuse leaves; leaf cells very long and narrow, 10–20 : 1. Stem leaves abruptly and slenderly acuminate in most species. Seta rough; capsule as in *Brachythecium.* All of our species are western. *S. illecebrum* and *S. caespitosum* are also European.

1. Leaves broadly ovate to suborbicular, without pointed apex or at most short-cuspidate; auricles distinct, consisting of plainly dilated cells; aquatic. *S. obtusifolium.*
   Leaves ovate to lanceolate; stem leaves slenderly acuminate, without distinct auricles; terrestrial. 2.
2. Leaf cells 14–18 : 1, differentiated basal and alar cells few. 3.
   Leaf cells 7–12 : 1, differentiated basal and alar cells in several rows. 4.
3. Branch leaves ovate-lanceolate to lanceolate, acute to acuminate; capsules suberect and nearly symmetric. *S. colpophyllum.*
   Branch leaves ovate to oblong-ovate, obtuse to abruptly short-acuminate; capsules horizontal and unsymmetric. *S. illecebrum.*
4. Branches slightly julaceous; capsules suberect and nearly symmetric. *S. caespitosum.*
   Branches strongly julaceous; capsules more arcuate and unsymmetric. *S. apocladum.*

This genus is perhaps too near *Brachythecium* and one species referred to it by most authors (*S. Californicum*) is most certainly a *Brachythecium.* The relationship with *Eurhynchium* is much more distant and Sullivant's reference of *S. colpophyllum* to that species is hard to understand when one has a large series of plants for comparison. The relationship between *S. colpophyllum* and *S. caespitosum* is so close that about half the specimens of the former in American herbaria have been referred to the latter.

I am greatly indebted to the United States National Museum, Harvard University, The University of Wisconsin, and Mr. J. M. Holzinger for the loan of specimens. The work has been largely done at the Herbarium of Columbia University and was made possible by the kindness of Prof. Underwood and Mrs. Britton.

SCLEROPODIUM ILLECEBRUM (L. *p.p.*) Br. Sch. Bry. Eur. *pl.* *557.* 1853

Muscus terrestris surculis kali geniculati aut illecebrae, aemulis etc. Vail. Botan. Paris 137, *pl.* *25. f. 7.* 1727.

Hypnum illecebrum L. *p.p.* Sp. Pl. 1129. 1753.

Hypnum Touretii Brid. Sp. Musc. **2**: 185. 1812.

Hypnum illecebrum Schwaegr. Suppl. **1**, part 2: 225. 1816.

Hypnum blandum Lyell in Hook. & Tayl. Musc. Brit., Ed. 2: 176. 1827. Suppl. *pl.* *5.* 1827.

Gametophyte in wide spreading mats, varying from dirty green to bright glossy green: stems 3–10 cm. long, creeping, irregularly divided, irregularly or often subpinnately branching, partially denuded of leaves in the older portions, sparingly radiculose, younger portions ascending and much like the branches: branches short, rarely reaching 1 cm. in length, julaceous, turgid, ascending to erect, more or less arcuate, usually obtuse: branch-leaves appressed imbricate when dry, erect open when moist, varying greatly in shape; those from the middle of the larger branches broadly ovate to oblong-ovate, 1.2×0.6 mm., abruptly narrowed to a short point, finely and sharply serrate above, sometimes nearly entire, very concave, slightly sulcate when dry, smooth when moist, not decurrent but half clasping, acumination of leaves often squarrose-spreading when dry; costa extending ¾ the length of the leaf, sometimes ending in a dorsal spine; median cells linear-vermicular, 0.005 mm. wide and 12–18 : 1, apical much shorter; basal subquadrate, colored and thicker walled; alar somewhat larger and less deeply colored; leaves of the shorter branches and upper and lower leaves of the longer branches often lack the acumination and are obtuse or obtusely acute: stem leaves averaging larger, in robust plants reaching 2.3×1 mm., gradually tapering to a longer acumination, nearly or quite entire, those of the younger stems scarcely to be distinguished from the branch leaves. Dioicous: perichaetial leaves oblong-lanceolate, gradually narrowed above to a slender entire or subdenticulate acumination, faintly costate, acumination less slender than in *S. caespitosum.*

Sporophyte 1–2 cm. high: seta greenish brown, becoming red brown with age, twisted to the right, very rough with large papillae: capsule a little lighter colored than the seta, horizontal, unsymmetric or arcuate, with operculum 2.5 mm. long, 2.5–3 : 1; operculum long-conic, acute; annulus of two rows of cells, easily deciduous; teeth united at base, nearly colorless and papillose above; segments nearly as long as the teeth, finely papillose, from basal membrane equaling two fifths the length of the teeth; cilia 2, well developed, appendiculate; spores nearly smooth, maturing in winter.

Forma *pinnatifidum* from California in the Gray Herbarium at Harvard is more slender and nearly regularly pinnate.

Type locality, France near Paris. Type at Paris.

On shady grassy soil and on shaded rocks.

California, Idaho, Washington, British Columbia, Vancouver.

EXSICCATI: Sulliv. & Lesq. Musc. Bor.-Am., Ed. 2, 508.

ILLUSTRATIONS: Bry. Eur. *pl. 557;* Husnot, Musc. Gall. *pl. 95;* Dixon & Jam. Handb. Brit. Mosses, *pl. 53, G;* Limpricht, Rab. Krypt. Fl. **4**: *f. 378.*

The robust habit, julaceous turgid branches, and thick unsymmetric horizontal capsules make this species easy to recognize when typical. It grades insensibly into *S. obtusifolium* and it is often very hard to say to which species certain forms should be referred.

SCLEROPODIUM OBTUSIFOLIUM (Hook.) Kindb. Cat. Can. Pl. **6**: 202. 1892

Hypnum obtusifolium Hook. Drumm. Musc. Am. no. 193.

Hypnum arcticum var. Muell. Syn. **2**: 432. 1851.

Stereodon obtusifolius Mitt. Journ. Linn. Soc. **8**: 42. 1865.

Gametophyte submerged or nearly so, attached to stones in brooks, light green above, brown below: stems irregularly branching, naked below and roughened by the leaf bases of the fallen leaves; young stems and branches julaceous; branches 5–20 mm. long: leaves close imbricate and appressed when dry, more open when moist, broadly ovate to suborbicular, very concave, spoon shaped, round-obtuse, without acumination or very shortly cuspidate, 1.2 × 1 mm., not plicate or sulcate except under pressure, entire or faintly denticulate near apex; costa stout, extending five sixths the length of the leaf; median leaf cells linear vermicular, 0.05–0.065 mm. long, 8–10 : 1; apical cells broader and shorter, 2–3 : 1; alar cells rather abruptly enlarged to form distinct auricles, 0.013 mm. long, 3 : 1.

Type from rivulets in the Rocky Mts., Drummond. Type not seen, probably at Kew.

Described from Drummond's Musc. Am. 193, which is sterile.

California, Nevada, Idaho, Montana, Washington, Oregon, British Columbia.

EXSICCATI: Macoun's Canadian Musci 359 is very much larger and in every way more robust than the type, but has all of the distinctive microscopic characters. The same is true of Renauld and Cardot's Musc. Sept. Exs. 111. Sullivant and Lesquereux, Musc. Bor.-Am., edition 2, no. 509 (*Hypnum illecebrum* var.), is fairly representative of the species and bears the mature sporophyte, which differs little from that of *S. illecebrum.* The capsule is a little shorter and there are sometimes as many as four strongly nodose cilia in the endostome: the seta is exceedingly rough with very high papillae: operculum short rostrate when dry.

There can be no doubt that this should be regarded as a subspecies of *S. illecebrum.* The plants nearest the type are always submerged and nearly always sterile. A complete series can be traced from the typical form described above to typical *S. illecebrum.* M. Cardot in Hedwigia **32**: 345. 1893, states that he has come to the conclusion that *S. obtusifolium* is a water form of *S. illecebrum* and states that the latter varies greatly in the characters which separate the two species. He also states that he has found these variations in the same tuft. It seems probable, however, from what he says that he had at hand specimens of the more common form of *S. obtusifolium*, which is more robust than the type or than *S. illecebrum* itself. Drummond's 193 is less robust than *S. illecebrum.*

M. Cardot also informs me that he and M. Renauld first suggested to Prof. Kindberg that *Hypnum obtusifolium* is a *Scleropodium.* This fact Prof. Kindberg failed to acknowledge in his publications.

Dr. M. A. Howe has collected specimens on moist, shady banks at Berkeley, California, June 28, 1894, that have the leaf characters of the typical form, except that the leaves are longer in proportion to their width. This goes to show that the submerged growth is not the cause of the inflated alar cells, shorter leaf cells and more concave leaves.

In some cases the plants are flaccid with more distant, less closely appressed leaves constituting forma *laxum.*

A form from Goldstream, Vancouver Island, Macoun, May 18, 1887, has erect branches 3–4 cm. long, strongly curved at the ends, bearing suborbicular, strongly secund leaves 2 mm. in length. For this I suggest the name var. *homomallum*. This variety is the extreme development of the robust form while the typical form is at the other extreme.

Scleropodium apocladum (Mitt.) .

Hypnum apocladum Mitt. Journ. Linn. Soc. **8**: 35. 1865.

Gametophyte in wide interwoven mats of medium thickness, light green above, dirty green below the surface, somewhat resembling *Eurhynchium strigosum praecox* in appearance: stems creeping, 1–4 cm. long, irregularly branching: branches often fascicled, simple or sparingly divided, 3–8 mm. in length, julaceous, attenuate: branch leaves appressed-imbricate when dry, those on the branches below the surface of the mat erect spreading, ovate, acute to short-acuminate, scarcely decurrent, slightly serrulate at apex, otherwise nearly entire in the type, other specimens finely serrulate nearly to the base, somewhat concave, not plicate or sulcate; costa extending at least four fifths the length of the leaf, stout; median cells linear-oblong, 7–9 : 1; quadrate basal and alar cells very numerous; apical cells broader and shorter; the leaves near the apex of the branches narrower and more longly acuminate: leaves of creeping stems variable in shape, semiorbicular and abruptly short-acuminate to ovate and longer acuminate. Perichaetium 4.5 mm. long, the inner leaves long lanceolate, long and slenderly acuminate, slightly serrulate, some faintly costate (Mitten says "nerved to above middle"). Sporophyte about 12 mm. high: seta red-brown, in the type plainly papillose with low distant papillae, in other specimens strongly roughened: capsule red-brown, about 2 mm. long, 3–4 : 1; "suberect, oval cylindrical," in other specimens inclined to horizontal, unsymmetric; operculum conic-apiculate; annulus of two rows of cells; segments nearly as long as the teeth, split between the articulations; cilia two, strongly appendiculate; spores smooth, 0.013 mm.

A fragment of Mitten's type from "The Northwest Coast, Douglas" has been accessible, and a specimen from the United States National Museum collected at Pasadena, California, by Dr. Palmer, and determined as *S. caespitosum* has been carefully compared with this fragment. The two agree in all essential particulars. The leaves of Dr. Palmer's specimen are more acuminate and more serrulate, the seta is rougher and the capsule more unsymmetric and inclined, but these differences are no greater than frequently occur in individuals of the same species. The seta in the type is much rougher than the original description would lead one to expect.

The leaf cells are much shorter than in most species of the genus, but in all other particulars it seems closely related to the other species.

Type in Mitten Herbarium.

SCLEROPODIUM CAESPITOSUM (Wils.) Br. & Sch. Bry. Eur. *pl. 556.* 1853

Hypnum caespitosum Wils. English Bot. Suppl. *pl. 2878.* 1849. Also Bry. Brit. 344. *pl. 55.* 1851.

Hypnum caespitans C. Muell. Syn. **2**: 354. 1851.

Eurhynchium colpophyllum flagelliforme Barnes, Bot. Gaz. **16**: 207. 1891.

Gametophyte in rather thin loosely interwoven mats, light or dirty green: stems creeping, 5–10 cm. long, irregularly divided and branching; branches usually longer and more slender than in *S. illecebrum*, tapering, sometimes julaceous, but less frequently so than in *S. illecebrum:* branch leaves, from the middle of the branches 0.9–1 × 0.3–0.4 mm., ovate to oblong-lanceolate, usually tapering and acute at apex but sometimes nearly as obtuse as in *S. illecebrum*, appressed and imbricate to erect-open when dry, concave, scarcely plicate when moist, not decurrent, finely serrate at apex; median cells narrowly linear-vermicular, 8–12 : 1; quadrate basal cells in several rows, alar little differentiated from the other basal cells; apical cells broader and shorter; costa stout, frequently forked, extending three fourths the length of the leaf, often ending in a spine at the back of the leaf; stem leaves ovate to ovate-lanceolate, slenderly acuminate, with a larger number of short basal and alar cells, alar cells somewhat enlarged at the decurrent angles. Dioicous; inner perichaetial leaves loosely sheathing at base, gradually narrowed to a long subfiliform and suberect acumen, distantly and slightly denticulate above or sometimes entire, faintly costate.

Sporophyte 10–15 mm. high: seta red-brown, twisted to the right, very rough: capsule light brownish-green, oblong cylindric, suberect, slightly unsymmetric, with operculum 2–2.5 mm. long, about 2.5 : 1; operculum conic-apiculate to conic-rostellate, often appearing short rostrate when dry; annulus of two rows of cells, deciduous; teeth of peristome slender, subhyaline and slightly papillose at apex; segments nearly as long as the teeth, yellowish, more strongly papillose, from a wide basal membrane and widely open between the articulations; cilia two, very strongly nodose; spores rough, about .016 mm., maturing in winter.

Type locality, Langford, near Warrenton, England.

Growing on stumps and old logs, roots of trees and rocks. California, Washington, Oregon, Vancouver Island, Lake Athabasca (Macoun), Alaska (Kellogg).

ILLUSTRATIONS: See above; also Dixon and Jameson, *pl. 153, B;* Husnot, Musc. Gall. *pl. 115.*

EXSICCATI: As *Hypnum caespitosum;* Sull. & Lesq. Musc. Bor.-Am. 510; Macoun, Can. Musc. 290 (In part only. See under *S. colpophyllum.*)

Sterile and robust *S. caespitosum* is hard to distinguish from *S. illecebrum.* In general it is more slender, less frequently julaceous with closely imbricated leaves, with tapering branches and narrower more gradually tapering leaves having their median lea cells longer and rather narrower and the differentiated basal cells more numerous. It also comes very close to slender forms of *S. colpophyllum.*

Sullivant and Lesquereux's exsiccati (*l. c.*) do not agree very closely with Wilson's Musc. Brit. 349, or with the plate in the Bryologia Europaea. The stem leaves are too abruptly acuminate with too short an acumen. This is a variation in the direction of *S. obtusifolium,* but as these characters are variable according to Wilson's own description, these specimens should probably be referred to a form of *S. caespitosum.* Dr. M. A. Howe has collected a moss on "Redwood stumps, Mill Valley, Marin Co., California, January 16, 1892," that agrees very closely with Wilson's exsiccati so that there can be no reasonable doubt of the identity of the European and American plant.

I feel quite sure that *Hypnum lentum* Mitt. Journ. Linn. Soc. **8**: 36. 1865, is at least nothing more than a variety of *S. caespitosum,* and probably is identical with it. *S. caespitosum* was very little known at the time *Hypnum lentum* was published and a careful reading of the original description will fail to show any distinctions of importance between the two. The matter cannot be definitely settled until Mitten's type is accessible.

SCLEROPODIUM CAESPITOSUM SUBLAEVE R. & C. Bot. Gaz. **15**: 61. 1890

"Pedicel nearly smooth, slightly rough only below the capsule. Oregon, Suavies Island (Th. Howell)." M. Cardot very kindly sent me a portion of this for examination. It agrees with the typical form except as noted above.

Scleropodium colpophyllum (Sulliv.)

Eurhynchium colpophyllum Sulliv. Icon. Musc. Suppl. 95. *pl. 71.* 1874.

Brachythecium colpophyllum Kindb. Can. Rec. Sci. 1894: 73. 1894.

Eurhynchium Macounii Kindb. Rev. Bryol. **22**: 85. 1895.

Gametophyte in wide, soft intricate mats, dirty green: stems creeping radiculose, about 5 cm. long, often stoloniferous, much elongated: branches numerous, erect, about 5 mm. long, teretefoliate, often julaceous: branch leaves closely imbricate when dry, erect-spreading when moist, not decurrent, oblong-lanceolate to broadly-ovate-lanceolate, 1.3–1.5 × 0.45–0.6 mm., acute or broadly acuminate, serrate above, very concave, scarcely plicate; costa extending four fifths length of leaf, ending in a spine on the underside; median leaf-cells long linear, 14–18:1; basal somewhat shorter and broader; a few of the alar cells quadrate: stem leaves triangular-ovate, long and slenderly acuminate, 1.3–1.8 × 0.8 mm. Dioicous, perichaetial leaves with sheathing bases and loosely erect open points, oblong-ovate, slenderly acuminate, costate, nearly entire.

Sporophyte about 15 mm. high: seta light brown, flexuous, twisted to the right, rough with rather distant conical papillae: capsule brown, oblong cylindric, suberect, more or less arcuate, with the operculum about 2 mm. long, 2.5–3:1; slightly constricted under the mouth when dry; operculum conic-rostrate; annulus present, of two rows of cells, easily detachable; segments nearly as long as the teeth, widely split: cilia 2, strongly nodose or subappendiculate; spores minutely roughened, 0.012–0.016 mm., maturing in autumn.

Type locality, California, Bigelow. Type in the Gray Herbarium; examined by the author.

Not rare in California, but frequently confused with *S. caespitosum;* Vancouver Island, Macoun; Alaska, Kellogg.

ILLUSTRATIONS: Sulliv., *l. c.* Evidently Sullivant did not figure any stem leaves as those on the type specimen are quite different from any in the figure in the Icones.

This species is much nearer slender-leaved forms of *S. caespitosum* than is generally recognized. It is distinguished from *S. caespitosum* by its narrower more slenderly acuminate branch leaves, which are more sharply serrate, with median cells longer and narrower, enlarged basal and alar cells much less numerous. In gross appearance the whole plant, and particularly the branches, is much longer. It is undoubtedly a derivative of *S. caespitosum* and intermediate forms are not very rare.

Type specimens of var. *flagelliforme* Barnes have the shorter median cells and the more numerous differentiated basal cells of *S. caespitosum* and seem to me to belong to that species. The slender flagelliform branches are not rare in *S. caespitosum.*

Scleropodium Macounii Kindb. was founded on Macoun's Canadian Musci no. 290. According to the statement of Professor Macoun himself, this number is made up of two collections numbered originally 33 and 212. I find that 33 in his herbarium is *S. colpophyllum* and 212 is *S. caespitosum.* I have examined several of Canadian Musci no. 290 and have found some to be *S. caespitosum* and others to be *S. colpophyllum.* This makes it reasonably sure that *S. Macounii* is a synonym of *S. colpophyllum.* Kindberg states that *S. Macounii* is "monoecious." In this I think he is mistaken, for a careful examination of one of the specimens of 290 which I referred to *S. colpophyllum* showed it to be distinctly dioicous. The male plants were, however, so closely intertwined with the female that at one time I made the same mistake, which was corrected later by a more critical study. Kindberg characterizes the branch leaves as "obtusate." As I am uncertain as to the meaning of the term I do not feel sure whether it tallies with my conclusions or not.

Scleropodium colpophyllum attenuatum var. nov.

Stoloniferous, much more slender with more distant loosely spreading leaves: leaves much narrower with a longer and more slender acumination: branch leaves varying from 1.7 × 0.54 mm. on the longer branches to 1 × 0.2 on the smaller.

Type from perpendicular rocks, Victoria, Vancouver Id., May 2, 1893, Macoun.

Type in the herbarium of the Geological and Natural History Survey of Canada at Ottawa.

DOUBTFUL AND LITTLE KNOWN SPECIES

HYPNUM LENTUM Mitt. Journ. Linn. Soc. **8**: 36. 1865 is undoubtedly a *Scleropodium* and I am confident that it is at most nothing but a variety of *S. caespitosum.* *Vide* notes under that species.

SCLEROPODIUM KRAUSEI (Muell.) R. & C. Rev. Bryol. **20**: 19. 1893.

Hypnum Krausei Muell. Flora **70**: 224. 1887.

M. Jules Cardot very kindly obtained a portion of Müller's type of *Hypnum Krausei* from the Royal Botanical Museum, at Berlin, and sent it to me for examination. In his letter M. Cardot states that it seems to him to belong rather to *Limnobium* than to *Scleropodium.* I entirely agree with this view, for the general habit, the smooth seta, and the costa frequently short and double or forked point very strongly to a close relationship with *Limnobium.*

EXCLUDED SPECIES

SCLEROPODIUM CALIFORNICUM (Lesq.) R. & C. Rev. Bryol. **20**: 20. 1893 is plainly a *Brachythecium* and was so published by Jaeger and Sauerbeck, St. Gall. Nat. Gesell. 1877–78: 326.

EURHYNCHIUM SUBCAESPITOSUM Kindb. Rev. Bryol. **22**: 84. 1895, which he puts in the subgenus *Scleropodium* in the original publication is nothing but a form of *Brachythecium asperrimum* according to specimens kindly communicated by Prof. Macoun.

New Species from the Western United States

By P. A. Rydberg

Juncus Suksdorfii

Stem about 3 dm. high, strict, light green, 2–3 mm. in diameter; leaves terete or slightly flattened, distinctly septate; the basal ones short; stem leaves, except the upper ones, often 3 dm. long all with a conspicuous, scarious sheath; heads in a contracted panicle, brown and shining, 5–8-flowered; bracts ovate, cuspidate-acuminate; perianth segments subequal, about 4 mm. long, narrowly lanceolate, acute or acuminate; stamens 6; anthers longer than the filaments; style long-exserted; capsule dark brown and shining, oblong, acuminate, 3-angled.

Dr. Watson has labeled this *Juncus Nevadensis* var., to which it may be nearest related if the structure of the flower is taken in consideration. It is different in habit, however, being much stouter, having more numerous and larger heads, and longer leaves.

Washington: Falcon Valley, 1883, *Suksdorf, 217*; 1885, *680*; Spangle, Spokane Co., 1884, *464* (all in Gray Herbarium).

Allium Neo-Mexicanum

Bulb oblong, membranaceous, crowning a more or less persistent rhizome; coat membranaceous; scape slender, terete; leaves narrow, 1–3 mm. wide, apparently almost flat, slightly keeled; umbel 8–20-flowered, nodding; involucre very small; perianth-segments oblong-ovate, acute, nearly white, without a distinct midvein; stamens and style exserted; capsule 6-crested.

This resembles most *A. cernuum*, but differs in the fewer flowered umbel, the narrower perianth-segments, and in the thinner and narrower leaves, which are only slightly keeled.

New Mexico: Organ Mountains, 1894, *E. O. Wooton;* 1851–2, *C. Wright*, 1913.

South Colorado: 1861, *C. C. Parry, 350.*

Arizona: Tanners Cañon, 1892, *Dr. T. E. Wilcox.*

Astragalus Cusickii

Perennial from a creeping rootstock: stem about 5 dm. high, strigose, somewhat branched; leaves pinnate of 6–9 pairs of linear leaflets which are 2–3 cm. long and about 2 mm. wide, glabrous above and slightly strigose beneath; raceme with a 1–2 dm. long peduncle, rather lax and few-flowered; flowers almost sessile, about 12 mm. long; calyx about 7 mm. long, strigose with dark hairs; lobes short, lanceolate and unequal; corolla yellow; pod with a stipe which is about 1 cm. long and curved upwards, upright, oblong, obcordate in cross-section, with the dorsal suture strongly inflexed to about half-way to the ventral one, subcoriaceous, the body being about 2 cm. long.

The specimens were named *A. arrectus* Gray?, to which species it has a superficial resemblance, differing in the pod, the structure of which places it near *A. Drummondii* and *A. scopulorum*. From these it differs, however, in the short erect pod. It grows on dry hillsides.

OREGON: Malheur, 1885, *W. C. Cusick, 1238* (Gray Herbarium).

Potentilla rosulata

Glandular and viscid pubescent throughout; caudex thick and lignose, topped with dense rosettes of leaves and short stems; the latter, at least in the type specimens, less than 1 dm. high; basal leaves 4–5 cm. long, long-petioled, pinnately 5-foliolate; stem-leaves ternate, short-petioled, or the upper subsessile; lower stipules lanceolate and thin; the upper ovate and rather thick; leaflets thick, densely viscid and glandular pubescent, broadly obovate, or the terminal orbicular, deeply crenate, or somewhat cleft, 7–10 mm. long; pedicels 5–15 mm. long; hypanthium about 5 mm. in diameter, densely viscid pubescent; bractlets ovate, about half as long as the broadly triangular ovate acute or acuminate sepals; petals small, oblong, whitish or light yellow, about as long as the bractlets; stamens between 30 and 40; anthers decidedly didymous; pistils 20–40; style filiform, attached near the apex of the ovary.

This is nearest related to *Potentilla saxosa* Greene,* but differs in the less numerous leaflets of the basal leaves, the much thicker and less incised leaflets, the shorter and stouter stems, the smaller petals and the shorter hairs of the receptacle. It resembles also *P. rivalis* somewhat in habit and leaves, but it has a thick perennial caudex, much more numerous stamens and filiform style.

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* In my monograph I transferred this species to *Horkelia*, on account of its close resemblance to *Horkelia Baileyi*, but a study of better material in Mr. T. S. Brandegee's herbarium has persuaded me that I made a mistake. The species is a true *Potentilla*. There are three species, all belonging to the *Potentilleae*, that are almost identical in the vegetative parts, but still must be placed in three different genera. These are: *Potentilla saxosa* Greene, *Horkelia Baileyi* Wats., and *Purpusia saxosa* Brandegee.

CALIFORNIA: 29 Palms, Colorado Desert, 1898, *A. H. Alverson* (type in the herbarium of *T. S. Brandegee*).

Horkelia chaetophora

Caudex stout, covered with the remains of leaf-stalks and stipules from former years; stems several, 1–1.5 dm. high, almost scapose, finely puberulent; basal leaves numerous, about 1 dm. long, with 15–20 pairs of leaflets; their stipules broad, brown, obtuse, bristly ciliate; leaflets 3–5 mm. long, divided to near the base into linear-oblong segments, densely puberulent and tipped with bristles; cyme rather many-flowered and open; hypanthium 5–7 mm. in diameter, puberulent and hirsute; bractlets linear-oblong, one third shorter than the broadly lanceolate acute sepals; petals yellow, oblong, about equaling the sepals; stamens 10; filaments filiform; pistils about 20.

This is intermediate between *H. Utahensis* and *H. pygmaea.* It resembles the former most in habit and flowers, but has the bristles and obtuse stipules characteristic to *H. pygmaea.* From the latter it differs in the larger size of the plant and flower and the many-flowered and open cyme. It grows in rocky places in the mountains at an altitude of 3000–3400 m.

CALIFORNIA: Farewell Gap and Little Kern River, Tulare Co., 1896, *C. A. Purpus, 1409;* Keweah Peak, 1895 (both in the herbarium of T. S. Brandegee).

Horkelia Congdonis

Perennial with a woody caudex; stems erect, 3–4 dm. high, few-leaved, somewhat branched above, glandular puberulent; basal leaves 1–1.5 dm. long, with 30–40 pairs of leaflets; stem-leaves similar but smaller; upper stipules deeply cleft; leaflets 3–5 mm. long, cleft to the base into 4–5 oblong divisions, obtuse, glandular puberulent; cyme with a few ascending branches and short-pediceled flowers; hypanthium campanulate, 7–8 mm. in diameter, glandular puberulent; bractlets lanceolate, one half or two thirds the length of the lanceolate acuminate sepals; sepals almost equaling the sepals, oblong, obtuse; stamens 20; filaments slightly dilated, subulate; pistils numerous.

This is nearest related to *Horkelia purpurascens*, but differs in the taller habit, the more branched cyme, the more acuminate sepals, which in the type specimens are not reflexed, and the petals, which are not retuse or emarginate as in that species.

CALIFORNIA: Casa Diabolo, 1895, *J. W. Congdon* (type in the herbarium of T. S. Brandegee).

Mertensia tubiflora

Perennial; stem 2–3 dm. high, glabrous striate, and somewhat angled, branched above; basal leaves oblanceolate, short petioled; stem-leaves sessile, lanceolate to ovate, about 4 cm. long and 1–2 cm. wide, glabrate, except the hispid ciliolate margins, muricate above, obtuse; panicle contracted; pedicels very slender and drooping, about 1 cm. long, strigulose; calyx slightly strigose, about 4 mm. long, cleft half-way into oblong-lanceolate acutish lobes; corolla 13–15 mm. long; tube about 10 mm. long and 3 mm. in diameter, more than twice as long as the limb; the latter campanulate with very short lobes; nutlets very strongly muricate.

This species combines the general habit of *M. lanceolata* with a corolla which is most like that of *M. oblongifolia.*

WYOMING: Headwaters of the Tongue River, Big Horn Mountains, July, 1898, *F. Tweedy, 119.*

Symphoricarpos Utahensis

Symphoricarpos montanus Wats. King's Exp. **5**: 132 partly; not H.B. K.

Shrub a meter or more high, with brownish bark; leaves broadly ovate, more or less rounded at both ends, obtuse or often mucronate, often coarsely sinuately toothed, pubescent when young, glabrate in age, 3–4 cm. long and 2–3 cm. wide; flowers in terminal one-sided, drooping short spikes, or with smaller clusters in the upper axils; corolla somewhat funnelform, about 8 mm. long.

This resembles most *S. racemosus* in inflorescence and leaves, but differs in the form of the corolla. The inflorescence, the larger and less pubescent leaves and the size of the bush separate it from *S. rotundifolius.*

UTAH: Logan, August, 1895, *P. A. Rydberg* (Type); Wahsatch Mountain, 1869, *S. Watson, 475,* in part.*

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* Watson includes under this number not less than three distinct forms. Of these one belongs to this species, one from Virginia Mountain, Nevada, to *S. oreophilus,* and the third from the Uintahs to the next or an undescribed species.

Symphoricarpus Parishii

Apparently rather tall shrub for the group; bark of the old stems gray, of the young twigs brown; leaves of older stems small, about 1.5 cm. long, narrowly oval, acutish at both ends, densely pubescent, more or less bluish green, rather thick; those of the young shoots larger, about 3 cm. long, deeply 3-lobed and coarsely toothed; corolla elongated campanulate, 6–7 mm. long.

This resembles mostly *S. rotundifolius* in pubescence and flowers, but is evidently a larger plant and the leaves are bluish green and acutish at both ends. It seems to be confined to Southern California.

CALIFORNIA: San Bernardino Mountains, 1892, *S. B. Parish, 2514;* 1894, *3024.*

Erigeron flabellifolius

Perennial with a long slender creeping rootstock; stem 1–2 dm. high, few-leaved, glandular puberulent above; basal leaves petioled, about 3 cm. long, slightly glandular puberulent, cuneate-flabelliform in outline, deeply 3–5-cleft into cuneate 3-lobed divisions or the lower simply 5–9-lobed at the apex; stem-leaves cuneate or obovate, smaller, subsessile and less divided; heads about 10 mm. high and 10–15 mm. in diameter; bracts linear, acuminate, with more or less spreading tips, dark brown or purplish black, glandular puberulent; rays 7–8 mm. long and 1.5–2 mm. wide, light pink or white.

This is a member of the *E. compositum* group, easily distinguished from its relatives by the form of the leaves, which are never compound, but simply cleft two thirds their length or less. It is also characterized by the lack of hirsute pubescence generally found in that group. It grows in rocky slides at an altitude of 3600 m.

WYOMING: Yount's Peak, Teton Forest Reserve, August, 1897, *Tweedy, 536.*

Erigeron spathulifolius

Perennial from an ascending rootstock; stems 5–8 cm. high, generally ascending, glabrous or slightly puberulent above, 3–5-leaved; basal leaves about 2 cm. long, perfectly glabrous, somewhat fleshy, broadly spatulate, tapering into a short petiole, entire-margined, obtuse or acutish; stem leaves 1–1.5 cm. long, linear-oblong or oblanceolate, sessile, obtuse; head solitary, 7–8 mm. high and 10–15 mm. in diameter, excluding the rays; bracts linear-lanceolate, acute, black, slightly puberulent; rays light blue, in age white, about 8 mm. long and 2–3 mm. wide.

In leaves and heads, this resembles most *E. simplex* Greene, but has a different root-system, is a much more glabrous plant and lack altogether the long villous hairs on the involucre characteristic of that species. On account of its root-system, it may be associated with *E. ursinus* and *E. radicatus*, but lacks the hirsute pubescence of those species and has broader rays. The same characters, together with the single head and broad leaves, separate it from *E. Eatonii*, which also has somewhat the same habit. It is an alpine species growing at an altitude of 3000 m. or more.

WYOMING: Black Rock Creek, Teton Forest Reserve, August, 1897, *Tweedy*, *543*.

Antennaria angustifolia

Surculose-proliferous; leaves of the stolons linear or linear-oblanceolate, about 1.5 cm. long, finely tomentose on both sides; stem-leaves narrowly linear, erect, the uppermost subulate; heads few in a subcapitate cluster, 4–5 mm. high; involucre campanulate, tomentose at the base; bracts of the fertile head linear-oblong, acute, yellowish or brownish white.

This is nearest related to *A. parvifolia* and *A. microphylla*, from which it differs in the subcapitate heads and the very narrow leaves.

CALIFORNIA: Yosemite Valley, 1865, *J. Torrey* (labeled *A. stenophylla?*); Hat Creek, J. S. Newberry (labeled *A. luzuloides*; both in the Torrey Herbarium).

New and interesting Plants from Western North America.—VI

By A. A. Heller

Quamasia azurea sp. nov.

Stems 3.5–4 dm. high from a deep-seated bulb, glabrous, sparingly leafy below: leaves about two thirds the length of the stem below the inflorescence, linear, 4–6 mm. wide, acute, prominently nerved, somewhat glaucous beneath: flowers scattered, the internodes from 1–2 cm. apart; pedicels slender, but becoming slightly thicker in fruit, 1.5–2 cm. long: bract at the base of the pedicel about as long as the pedicel, bluish or straw-colored, chaffy, lanceolate, tapering into a long slender acumination, prominently veined: perianth bright blue, 2 cm. or slightly more in length, the segments persistent, about 4 mm. wide, 5-nerved: capsule 1.5 cm. high, 1 cm. broad, three-angled: seeds black, shining.

Our no. 3933, collected near Montesano, Chehalis county, Washington, June 13, 1898, on grassy slopes. The type specimen is in my private herbarium.

This species differs considerably in habitat from *Q. Quamash*, which is usually found in places where there had been considerable moisture in early spring, while later in the season, the ground becomes dry and baked. The flowers of *Q. Quamash* are less delicate, and are of a rich blue-purple color.

Clematis Arizonica sp. nov.

Stems 2–3 dm. high, sparingly branched near the base, pubescent, especially above, with scattered, wool-like hairs, red below, green above and strongly angled: leaves all at right angles to the stem, and leaf branches horizontal to the rachis, bipinnate, petioled, the petioles about 2 cm. long; leaf segments linear, very narrow, 1 mm. wide, the rachis and leaflets sparingly pubescent: flowers not seen: styles plumose, 2–3 cm. long, recurved, the plumes slightly tawny.

Dr. D. T. MacDougal's no. 343, collected "on rocky slopes of Walnut Cañon," near Flagstaff, Arizona, July 25, 1898. The type specimen is deposited in the herbarium of the New York Botanical Garden.

Related to the plant called *Clematis Douglasii*, but having an entirely different geographical range, and differing in the following particulars from that species: It branches not from the root, but at a distance of 5 cm. or more above the root; in the rectangular instead of acute angled system of leaf branching; shorter peduncles; styles about one third shorter, with yellower plumes.

Aragallus pinetorum sp. nov.

Plant 3–4 dm. high, floccose or lanate throughout, especially at the base of the stems and in the inflorescence: stems multicipital from a long stout deep-seated root, their bases clothed with thin woolly acuminate scales: leaves all radical, extending to the inflorescence, petioles about one third the length of the blade, dilated at base; on fully developed leaves, the leaflets in 7–9 subopposite pairs, lanceolate or oblong-lanceolate, cuspidate, very shortly petiolulate, about 2 cm. long, 5 mm. wide, midvein prominent: bracts at base of the flowers lanceolate, acuminate, 7 or 8 mm. long, chaffy in texture: calyx 1 cm. or slightly more in length, the lobes lanceolate, 2 mm. long, except the middle lower one, which is often double the length of the others: flowers white, unspotted: pods ovate, when mature 2 cm. long, including the acuminate curved point: seeds pale brown, smooth.

Our no. 3751, collected on gravelly hills thinly clothed with pine trees, at a point eleven miles southeast of Santa Fé, New Mexico, June 23, 1897. The type specimen is in my private herbarium.

Specimens were distributed as "*Spicsia albiflora* Heller, n. sp.," a short time before the fact was ascertained that *Aragallus* is the proper name for our American plants. Publication was deferred until an opportunity offered for further study of the group to which the species belongs. In the meantime, without having consulted me, Prof. Aven Nelson described "*Aragallus albiflorus*,"* basing his description upon a plant from Wyoming, but using the specific name applied by me to this New-Mexican plant, and citing my number as a part of his species. A very cursory examination of the two plants, shows them to be distinct. My plant is more nearly related to *Aragallus collinus* Aven Nelson, published in the same paper.

Mertensia platyphylla sp. nov.

Plant large but weak, 4–7 dm. high, branched above, the branches slender and spreading, glabrous: leaves all thin, light green, papillately roughened on the upper side: root leaves usually about 3 dm. long, including the petiole of almost 2 dm., which is rough on the margin: blade broadly ovate, 6–10 cm. wide, abruptly acuminate, usually cordate at the base; lower stem leaves broadly ovate, abruptly acuminate, on margined petioles about 2 cm. long, the upper ones ovate-lanceolate, gradually acuminate, sessile or nearly so, contracted at the base: pedicels slender, 5–15 mm. long, pubescent with short appressed hairs; calyx deeply parted, the divisions narrowly linear-lanceolate, 5–7 mm. long, ciliate: corolla bright blue or turning to rose color, 10–12 mm. long, campanulate in general shape, flaring widely above the insertion of the stamens, the tubular portion about 3 mm. wide, while the width across the top is 5–8 mm; lobes 1–2 mm. long, with broad sinus at base, acutish at the apex: stamens included, anthers oblong: style slightly exserted.

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* Erythea 7: 57. 1899.

Our no. 3872, collected June 3, 1898, in rich moist ground, near streams, at Montesano, Chehalis county, Washington. The type specimen is in my private herbarium.

This well-marked species is readily distinguished from the eastern *M. paniculata* by its large, broadly ovate leaves, long calyx and large flowers.

Mertensia Franciscana sp. nov.

Stems 4–5 dm. high, smooth, branched above, the branches slender, sparingly pubescent with rough appressed hairs: leaves roughened with appressed hairs on the upper face and margins, the lowest ones ovate-lanceolate, bluntish, 6–7 cm. long, including the broadly margined petiole of about half that length, 15 mm. wide, the others up to the branches lanceolate, acute, 6–8 cm. long, 15 mm. wide, with gradually shortening petioles; those of the branches ovate-lanceolate, 3–5 cm. long, 1.5–2 cm. wide, sessile by a clasping base: inflorescence roughened with short appressed hairs; pedicels slender, short, 2–4 mm. long; calyx deeply parted, the divisions lanceolate, or when the flowers are closely clustered, oblong-lanceolate, 3 mm. long, 1 mm. wide; corolla purplish-blue, almost tubular in shape, only slightly enlarged at the insertion of the stamens, 8 mm. long, 2 mm. wide below the stamens, 3 mm. above: stamens and style included.

Dr. D. T. MacDougal's no. 232, collected July 15, 1898, "in moist soil under conifers near Hart Spring, San Francisco Mountain," near Flagstaff, Arizona. The type is deposited in the Herbarium of the New York Botanical Garden.

This is one of the western plants commonly referred to either the eastern *M. paniculata* or the far northern *M. Siberica.*

Mertensia pratensis sp. nov.

Stems usually several from a thick rootstock, 3–4 dm. high, leafy throughout, simple or nearly so, glabrous below the inflorescence, light colored below: leaves thin, bright green, the radical ones 7–12 cm. long including the petiole, the blade oval, obtuse or acutish, 3–4.5 cm. long, 2 cm. wide: stem leaves lanceolate, shortly acuminate, all but the lowest sessile: inflorescence compact, pubescent with short appressed hairs, especially the margins of the calyx lobes: pedicels slender, usually very short: calyx 3–4 mm. long, parted almost to the base, the divisions oblong or linear-lanceolate: corollas blue or pink, 17 mm. long, half of which length is tube, this 3 mm. wide, the upper dilated portion 6 or 7 mm. wide, with short, broad rounded lobes.

Our no. 3641, collected in a meadow in Santa Fé Cañon, nine miles east of Santa Fé, June 2, 1897. The type is in the herbarium of the New York Botanical Garden.

It was growing on the banks of Santa Fé creek, in company with *M. Fendleri*, but is easily distinguished from that good species by its taller growth, weaker stems, thin leaves, much smaller calyx, and larger flowers. It was distributed by me as "*Mertensia Sibirica.*"

Mertensia MacDougalii sp. nov.

Plant glabrous throughout, the upper part pruinose: stems stout, clustered from a thick rootstock, about 20 cm. high, stout, sparingly branched above, the branches very short; leaves glabrous, thin-coriaceous, ovate, or some oval, ranging from 3–5 cm. in length, 1–2.5 cm. in width, the lower ones contracting into broad petioles, rounded at the apex, the upper ones sessile and more acute: inflorescence secund; peduncles short and stout, the longest only slightly over 1 cm. in length; pedicels 5 mm. or less in length, rather stout: calyx broadly campanulate or cup-shaped, about 6 mm. high, and equally broad, the triangular-lanceolate lobes occupying two-thirds of the total length: corolla blue, 12 mm. long, the tubular portion the length of the calyx, the upper portion slightly dilated, 4 mm. wide at the top; corolla lobes short, 1 mm. long, broad and rounded: stamens included, oblong: style persistent, included in flower, but apparently elongating in fruit.

Dr. D. T. MacDougal's no. 95, collected near Mormon Lake, south of Flagstaff, Arizona, June 12, 1898, "in a meadow on the summit of Mormon mountain, near a small lake." This seems to be a well-marked species, differing considerably from the other species which are low, and bear rounded thickish leaves. The type specimen is in the herbarium of the New York Botanical Garden.

CREPIS ATRIBARBA Heller, Bull. Torr. Bot. Club, **26**: 314. 1899.

The specific name of this plant was by error spelled "*atrabarba*" in the original publication, and should be corrected in the place cited above.

Hymenopappus gloriosus sp. nov.

Stems 2–2.5 dm. high, multicipital from a stout root, somewhat floccose, evidently densely so when young: leaves basal, 4–6 cm. long, petioles as long as the blade, or slightly longer, with woolly bases, the other parts densely gray tomentose or floccose, primary divisions 1 cm. long, usually 4-divided, the divisions linear, 1 mm. wide, the edges inrolled; stem leaves reduced to two or three sessile bracts, the lower ones with several divisions: pedicels stout, 5 mm. long: heads 3 or 4, scattered, the lowest about 5 cm. from the uppermost, large, 1.5 cm. high, nearly 2 cm. broad; bracts of the involucre obovate, or some of the smaller outer ones oblong, 8 mm. long, 4 mm. wide, broadly margined with crimson, the middle portion green, tomentose: corollas bright yellow, 4 mm. high: achenes densely fringed with silky white hairs: pappus scales acute, slightly costate, a little longer than the width of the achene.

No. 71, collected by Dr. D. T. MacDougal on "dry slopes on eastern side of Mormon mountain," some distance south of Flagstaff, Arizona, June 7, 1898. The type specimen is preserved in the herbarium of the New York Botanical Garden.

This handsome species is related to *H. luteus* Nutt., but is easily distinguished by the broader leaf segments, the larger heads with crimson-edged scales, and the bright yellow corollas.

Hymenopappus obtusifolius sp. nov.

Perennial or perhaps biennial; stems corymbosely branched from near the base, 3 dm. high, floccose: leaves all white-tomentose beneath, the upper sides greener, mostly basal, these 5–7 cm. long, the petioles equaling the blades, divisions in three or four pairs, 1.5 cm. long, 5 mm. wide, obovate-oblong, obtuse; stem leaves few, scattered, sessile, gradually becoming smaller until reduced to oblong simple bracts, all obtuse: heads several, corymbose, 1 cm. broad; bracts of the involucre ovate-oblong, obtusish, 7 mm. long, 3–4 mm. wide, thin and scale-like, densely white tomentose: corollas dull yellow: achenes roughened on the margins: pappus scales very short, reduced to a mere fringe around the top of the achene.

Dr. D. T. MacDougal's no. 240, collected in "Fort Valley, west of San Francisco mountain," near Flagstaff, Arizona, July 5, 1898. The type specimen is in the herbarium of the New York Botanical Garden.

This excellent species is apparently related to *H. Mexicanus.*

Senecio spatuliformis sp. nov.

Stems about 3 dm. high, perennial, sparingly tufted: leaves nearly all basal, these 10–15 cm. long, spatulate or oblanceolate, slightly undulate-serrate, the apex blunt, or sometimes inclined to be acute, covered with a close floccose tomentum, except near the bases of the petioles; stem leaves very few, scattered, the lower ones mingled with the basal, and similar, those of the upper half sessile, linear, bract-like, midvein prominent and edges inrolled: heads ten or more in number, corymbose, large, 1 cm. high, nearly 2 cm. broad with the rays spread, on slender pedicels, the lower of which are 5 cm. long: involucral scales 1 mm. wide, pale, with a darker line along the middle, margins scarious: rays showy, bright yellow, 1 cm. long, 2 mm. wide; achenes glabrous, pappus white.

Our no. 4061, collected near Elma, Chehalis county, Washington, July 19, 1898. The type specimen is in my private herbarium.

It occurs sparingly in a dry meadow, or "prairie," as such open places are called in that part of the State, where open, grassy land is the exception. Its relationship is with the *Senecio canus* group.

BEDFORD PARK, NEW YORK CITY.

Mrs. Arvilla J. Ellis

Too often the ones who have ably assisted in carrying forward an important project are soon forgotten in the expressions of congratulation given to the man who leads the project. When the annals of botany are estimated with a just hand, the wives of botanists who have silently sacrificed in order that the husband's work could be more successfully carried to the end, will receive their due reward. The instances are not infrequent, moreover, where silent sacrifice has been supplemented by material aid from the same sources. To one of these this page is inscribed. Arvilla J. Bacon, daughter of Timothy and Mary S. Bacon, was born at Potsdam, New York, February 8, 1831, was married to Job Bicknell Ellis at the same place in 1856, and died at Newfield, New Jersey, July 18, 1899. With her husband she removed to Newfield, New Jersey, in 1865, and in addition to assisting to build the home, and caring for the household in sickness and in health, she took in various kinds of work to assist in the family support. In this country of poorly supported botanical workers, such is the too common lot of the wives of working botanists. But she did more than this. Besides binding many of her husband's books and pamphlets, she prepared some three thousand blank books in which the North American Fungi were issued and in which the greater part of the Ellis collection was mounted. Besides this she arranged at least three fourths of the 200,000 specimens which were issued in this series and in the Fungi Columbiani, folding papers, inserting specimens, pasting labels and inserting in their places. In the language of one who knew her best, the quiet spirit always acted on the principle, "Whatever thy hand findeth to do, do with thy might." It may justly be said that to her extended labor, none the less important and necessary because it was all what has so justly been characterized as "dead work," no less than to that of Mr. Ellis are American mycological students indebted for the valuable and extended issues of exsiccati that for the past twenty years have issued from this quiet house.

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Index to Recent Literature relating to American Botany

Abrams, Le R. The Structure and Development of *Cryptomitrium tenerum.* Bot. Gaz. **28**: 110–121. 24 Au. 1899. [Illust.]

Adamson, M. E. Teratological Notes on *Eschscholtzia Californica.* Erythea, **7**: 81, 82. 1 S. 1899.

Alpers, W. C. The Oil and Terpenes of *Aralia nudicaulis.* Am. Jour. Pharm. **71**: 370–378. Au. 1899.

Barnes, C. R. The Progress and Problems of Plant Physiology. Science, II. **10**: 316–331. 8 S. 1899.

Bicknell, E. P. Studies in *Sisyrinchium,* IV: *S. angustifolium* and related Species of the West and Northwest. Bull. Torr. Bot. Club, **26**: 445–457. 17 Au. 1899.

Sisyrinchium Idahoense, S. occidentale, S. segetum, S. leptocaulon, S. septentrionale, and *S. alpestre,* sp. nov.

Belajeff, W. Ueber die Centrosome in den spermatogenen Zellen. Ber. Deutsch. Bot. Ges. **17**: 199–205. *pl. 15.* 26 Jl. 1899.

Campbell, D. H. Studies on the Flower and Embryo of *Sparganium.* Proc. Cal. Acad. Sci. III. **1**: 293–324. *pl. 46–48.* 1899.

Cardot, J. Études sur la Flore bryologique de l'Amérique du Nord. Revision des types d'Hedwig et de Schwaegrichen. Bull. Herb. Boiss. **7**: 300–336. *pl. 7–10.* 29 Ap. 1899; 338–380. 31 My. 1899.

Cavara, F. I nuclei delle Entomophthoreae in ordine alla filogenesi di queste piante. Bull. Soc. Bot. Ital. 1899: 55–60. Mr. 1899.

Cordemoy, H. J. de. Sur une anomalie de la vanille. Rev. Gen. de Bot. **11**: 258–267. 15 Jl. 1899. [Illust.]

Cushing, H. B. & Campbell, R. The Gramineae, Cyperaceae and Juncaceae of Montreal Island. Can. Rec. Sci. **8**: 11–24. Ja. 1899.

Davis, B. M. The Spore-mother-cell of *Anthoceros.* Bot. Gaz. **28**: 89–109. *pl. 9–10.* 24 Au. 1899.

Drake del Castillo, E. Note sur le *Wickstroemia Balansae* Drake, et le *Poortmannia speciosa* Drake. Jour. de Bot. **13**: 135–139. My. 1899. [Illust.]

Eastwood, A. *Parnassia Californica* Greene. Erythea, **7**: 84. 1 S. 1899.

Fairchild, D. G. Notes of Travel, I. Bot. Gaz. **28**: 122–126. 24 Au. 1899.

Fernald, M. L. *Pycnanthemum verticillatum*, a misinterpreted Mint. Bot. Gaz. **28**: 130–133. 24 Au. 1899.

Fernald, M. L. *Eleocharis ovata* and its American Allies. Proc. Amer. Acad. **34**: 485–497. *pl.* 29 Ap. 1899.

Eleocharis obtusa jejuna, *E. obtusa gigantea*, *E. lanceolata*, *E. Engelmanni robusta*, *E. monticola*, *E. monticola leviseta* and *E. Macounii*, new species, varieties and names.

Fernald, M. L. *Scirpus Eriophorum* and some related Species. Proc. Amer. Acad. **34**: 498–503. 29 Ap. 1899.

Scirpus Eriophorum condensatus, *S. Eriophorum Andrewsii*, *S. atrocinctus* and *S. atrocinctus brachypodus*, new varieties and species.

Fullmer, E. L. The Development of the Microsporangia and Microspores of *Hemerocallis fulva*. Bot. Gaz. **28**: 81–88. *pl. 7, 8.* 24 Au. 1899.

Greenman, J. M. Some new Species, extended Ranges and newly noted Identities among Mexican Phanerogams. Proc. Amer. Acad. **34**: 566–578. 19 My. 1899.

New species in *Eleocharis*, *Smilax*, *Agave*, *Styrax*, *Sabbatia*, *Acerates*, *Macromeria*, *Solanum*, *Cestrum*, *Ruellia*, *Randia*, *Eupatorium*, *Grindelia*, *Baccharis*, *Desmanthodium*, *Bidens*, *Bahia*, *Cacalia*, and *Lactuca*.

Griffiths, D. Contributions to a better Knowledge of the Pyrenomycetes—I: A Study of miscellaneous Species. Bull. Torr. Bot. Club, **26**: 432–444. *pl. 365, 366.* 17 Au. 1899.

Melanospora Poae, *M. Townei*, *Pocosphaeria Allii*, *Pyrenophora Salsolae*, *Dothidea conspicua* and *Pleospora aquatica*, sp. nov.; *Trematosphaera caryophagae* (Schw.) nom. nov.; descriptions and figures of *Perisporium vulgare* Corda and of various species of *Sordaria*.

Guéguen, M. F. Coloration des spores des Ascomycètes et en particulier des ascospores des Levûres, par la méthode de Gram. Bull. Soc. Mycol. de France **15**: 189, 190. 31 Jl. 1899.

Guérin, P. The probable Causes of the poisonous Effects of the Darnel (*Lolium temulentum* L.). Bot. Gaz. **28**: 136, 137. 24 Au. 1899.

Hallier, H. Bausteine zu einer Monographie der Convolvulaceen. 9. Die von Caec. und Ed. Seler in Guatemala gesammelten Convolvulaceen des Berliner Herbars. Bull. Herb. Boiss. **7**: 408–418. 31 My. 1899.

Ipomoea microsticta, *Quamoclit gracilis* and *Q. brevipedicellata* sp. nov.

Hart, J. H. The Mango. Bull. Bot. Dept. Trinidad, **3**: 190–219. *f. 1–13.* Jl. 1899.

Hegelmaier, F. Ueber convolutive Cotyledonen. Ber. Deutsch. Bot. Ges. **17**: 121–138. *pl. 8.* 24 My. 1899.

Hennings, P. Uredineae aliquot brazilianae novae a cl. E. Ule lectae. Hedwigia (Beiblatt), **38**: (129), (130). 26 Je. 1899.

New species in *Uromyces*, *Puccinia*, *Uredo* and *Aecidium*.

Hermann, B. The United States Forest Ranger System. Forester, **5**: 195–199. S. 1899.

Hervey, E. W. Observations on the Colors of Flowers. 8vo. 1–105. New Bedford, 1899. [Illust.]

Hodson, E. R. Phenological Observations on the Growth of Corn. 1–8. Des Moines, 1898.

Holzinger, J. M. Botanical Work in the Grades and High Schools. Asa Gray Bull. **7**: 68–75. Au. 1899.

Hopkins, A. D. Report on Investigations to determine the Cause of unhealthy Conditions of the Spruce and Pine from 1880 to 1893. Bull. W. Va. Agric. Exper. Sta. 56: i–iv, 197–461. *f. 1–99.* Ap. 1899.

Hume, H. H. Fungi collected in Colorado, Wyoming and Nebraska in 1895, 1896 and 1897. Proc. Dav. Acad. Nat. Sci. **7**: 246–257. *pl. 17.* 1899.

Puccinia Crandallii, *Septoria Jamesii*, *Microstroma Americanorum*, new species.

Jaeger, L. Beiträge zur Kenntniss der Endospermbildung und zur Embryologie von *Taxus baccata* L. Flora, **86**: 241–288. *pl. 15–19.* 3 Au. 1899.

Johnson, A. C. A Forest Experimental Station. Forester, **5**: 185–187. Au. 1899.

Kinney, A. The Forest Problem in the West. Forester, **5**: 200–203. S. 1899.

Klebahn, H. Kulturversuche mit heteröcischen Rostpilzen, VII Bericht. Zeitsch. für Pflanzenkrankheiten, **9**: 137–160. 8 Jl. 1899.

Notes on various *Melampsorae* and *Pucciniae*.

Macchiati, L. Sopra uno Streptococco parassita dei granuli d'amido di frumento. Bull. Soc. Bot. Ital. 1899: 48–53. Mr. 1899.

Macchiati, L. Ufficio dei peli, dell' antocianina e dei nettarii estranuziali dell' *Ailanthus glandulosa* Desf. Bull. Soc. Bot. Ital. 1899: 103–112. Je. 1899.

Macchiati, L. Osservazioni sui nettarii estranuziali del *Prunus Laurocerasus* L. Bull. Soc. Bot. Ital. 1899. 144–147. Je. 1899.

Macoun, J. M. Contributions to Canadian Botany, XI. Can. Rec. Sci. **7**: 463–477. O. 1897.

Magnus, P. Ueber die bei verwandten Arten auftretenden Modificationen der Charaktere von Uredineen-Gattungen. Ber. Deutsch. Bot. Ges. **17** : 178–184. *pl. 12.* 26 Je. 1899.

Matruchot, L. & Dassonville, C. Sur le Champignon de l' Herpès (*Trichophyton*) et les formes voisine, et sur la classification des Ascomycètes. Bull. Soc. Mycol. de France. **15** : 240–253. *f. A.* 31 Jl. 1899.

Meehan, T. Mammillaria vivipara. Meehan's Monthly, **11** : 129, 130. *pl. 9.* S. 1899.

Malick, W. S. The State and Forestry. Forester, **5** : 179–181. Au. 1899.

Molisch, H. Ueber das Vorkommen von Indican im Chlorophyllkorn der Indicanpflanzen. Ber. Deutsch. Bot. Ges. **17** : 228–233. *pl. 18.* 26 Jl. 1899.

Nelson, A. Some Species of *Tetraneuris* and its Allies. Bot. Gaz. **28** : 126–130. 24 Au. 1899.

Tetraneuris acaulis caespitosa n. var.; *T. simplex*, *T. incana*, *T. Mancosensis*, and *Picradenia macrantha*, new species.

Niedenzu, F. De Genere Stigmatophyllo. Pars prior. (Dissertatio.) 1–16. Brunsbergae, 1899.

Pammel, L. H. Horse Nettle as a troublesome Weed in Iowa. Bull. Iowa Agric. Exper. Sta. 42 : 130–136. *f. 1–3.* 1899.

Pammel, L. H. Two other troublesome Weeds. Bull. Iowa Agric. Exper. Sta. 42 : 137–140. *f. 5, 6.* 1899.

Convolvulus arvensis and *Tribulus terrestris.*

Pammel, L. H. Some germination Study of Cereals. Proc. Soc. Pro. Agric. Sci. for 1898 : 194–203. 1899.

Pammel, L. H. Some ecological Notes on Iowa Grasses. Proc. Soc. Pro. Agric. Sci. for 1898 : 204–211. *pl.* 1899.

Pammel, L. H. Notes on Grasses of Nebraska, South Dakota and Wyoming. Proc. Dav. Acad. Nat. Sci. **7** : 229–245. *pl. 11–16.* 1899.

Melica Pammellii Scrib., *Poa Wyomingensis* Scrib., and *Hordeum caespitosum* Scrib., new species.

Pammel, L. H. Anatomical Characters of the Seeds of Leguminosae, chiefly Genera of Gray's Manual. Trans. St. Louis Acad. Sci. **9** : 91–273. *pl. 7–35.* 1899.

Pammel, L. H. Some ecological Notes on the Muscatine Flora. Plant World, **2** : 182–186. Au. 1899.

Passerini, N. Sulla presenza di fermenti zimici ossidanti nelle piante fanerogame. Nuovo Giorn. Bot. Ital. II. **6** : 296–321. Jl. 1899.

Patouillard, N. Champignons de la Guadaloupe. Bull. Soc. Mycol. de France, **15** : 191–209. *pl. 9, 10.* 31 Jl. 1899.

New species in *Armillariella*, *Androsaceus*, *Cynatella*, nov. gen., *Lentinus*, *Xerotus*, *Hypholoma*, *Agaricus*, *Psathyra*, *Ganoderma*, *Poria*, *Radulum*, *Thelephora*, *Stereum*, *Corticium*, *Hypochnus*, *Lycoperdon*, *Cycloderma*, *Mycenastrum*, *Sarcoscypha*, *Erinella*, *Glaziella*, *Cordyceps*, *Claviceps*, *Dichosporium*, nov. gen., and *Microstelium* nov. gen.

Peck, C. H. Plants of North Elba [New York]. Bull. N. Y. State Mus. **6** : 65–266. *map.* Je. 1899.

Purpus, C. A. Einiges über Vorkommen und Behandlung seltener Kakteen. Monatss. für Kakteenkunde, **9** : 93, 94. 15 Je. 1899.

Robinson, B. L. & Greenman, J. M. Supplementary Notes upon *Calea*, *Tridax* and *Mikania*. Proc. Boston Soc. Nat. Hist. **29** : 105–108. 24 Au. 1899.

Calea Pittieri and *Mikania Gonzalezii* sp. nov.; *Calea Oliveri* (= *C. ternifolia* Oliver) nom. nov.

Robinson, B. L. Three new Choripetalae from North America and Mexico. Bot. Gaz. **28** : 134–136. 24 Au. 1899.

Silene rectiramea, *Arabis Crandallii*, *Mimosa Acapulcensis*, new species.

Robinson, B. L. & Greenman, J. M. Revision of the Genus *Gymnolomia*. Proc. Boston Soc. Nat. Hist. **29** : 87–104. 24 Au. 1899.

Gymnolomia longifolia, *G. annua*, *G. hispida*, *G. hispida ciliata*, *G. patens Guatemalensis*, *G. patens brachypoda*, *G. patens macrophylla*, *G. serrata*, *G. megacephala*, *G. megacephala simulans* and *G. calva lancifolia* sp. et var. nov.; *Zaluzania Grayiana* (= *Gymnolomia triloba* Gray) nom. nov.

Robinson, B. L. & Greenman, J. M. Revision of the Genera *Montanoa*, *Perymenium* and *Zaluzania*. Proc. Amer. Acad. **34** : 507–534. 19 My. 1899.

Contains description of various new species and varieties.

Robinson, B. L. & Greenman, J. M. Synopsis of the Genus *Verbesina*, with an analytical Key to the Species. Proc. Amer. Acad. **34** : 534–566. 19 My. 1899.

Includes descriptions of many new species and varieties.

Rothrock, J. T. The Butternut or White Walnut. Forest Leaves. **7** : 56. *pl.* Au. 1899.

Saunders, C. F. Carices in the Vicinity of Philadelphia. Asa Gray Bull. **7** : 76, 77. Au. 1899.

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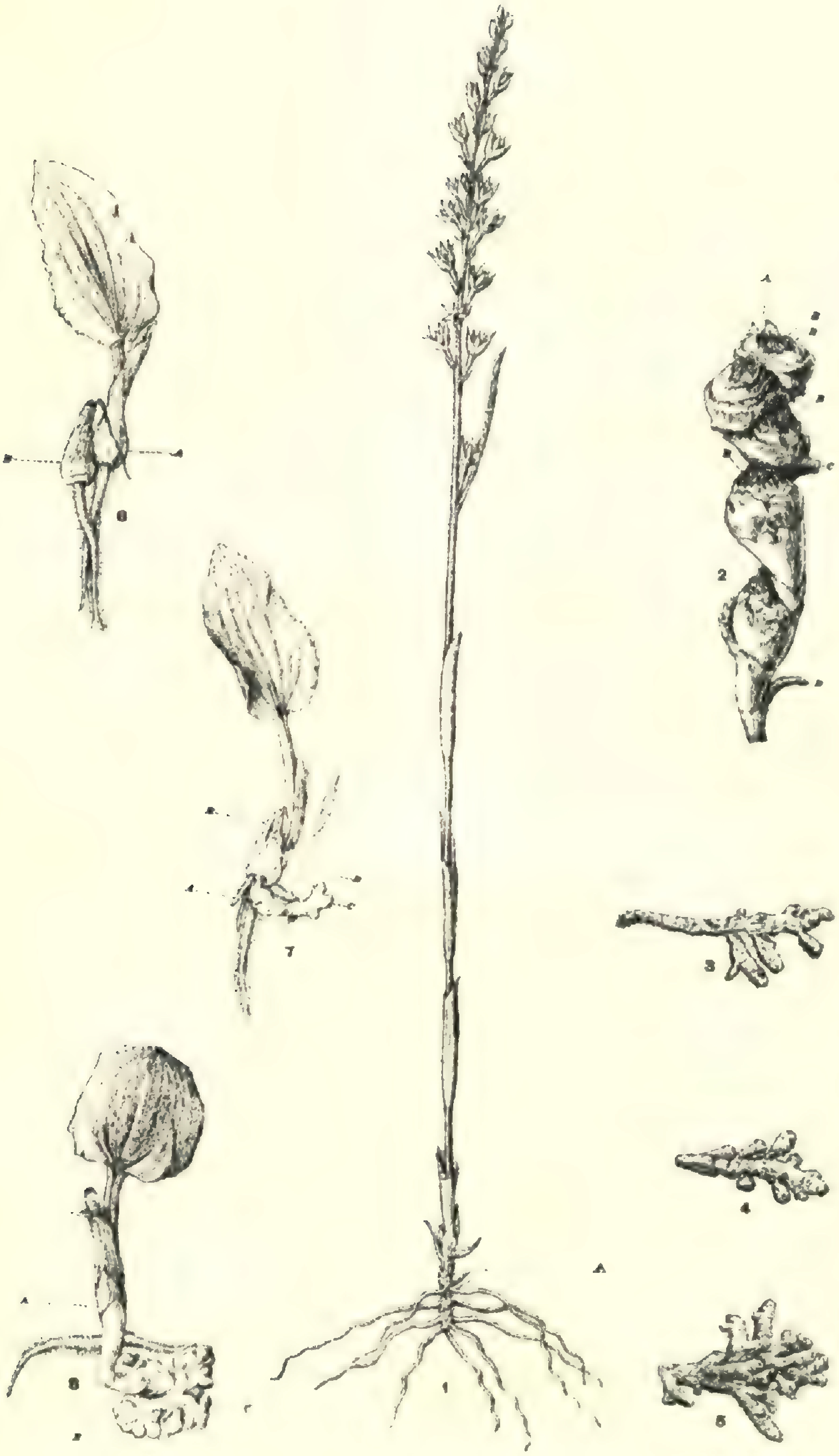

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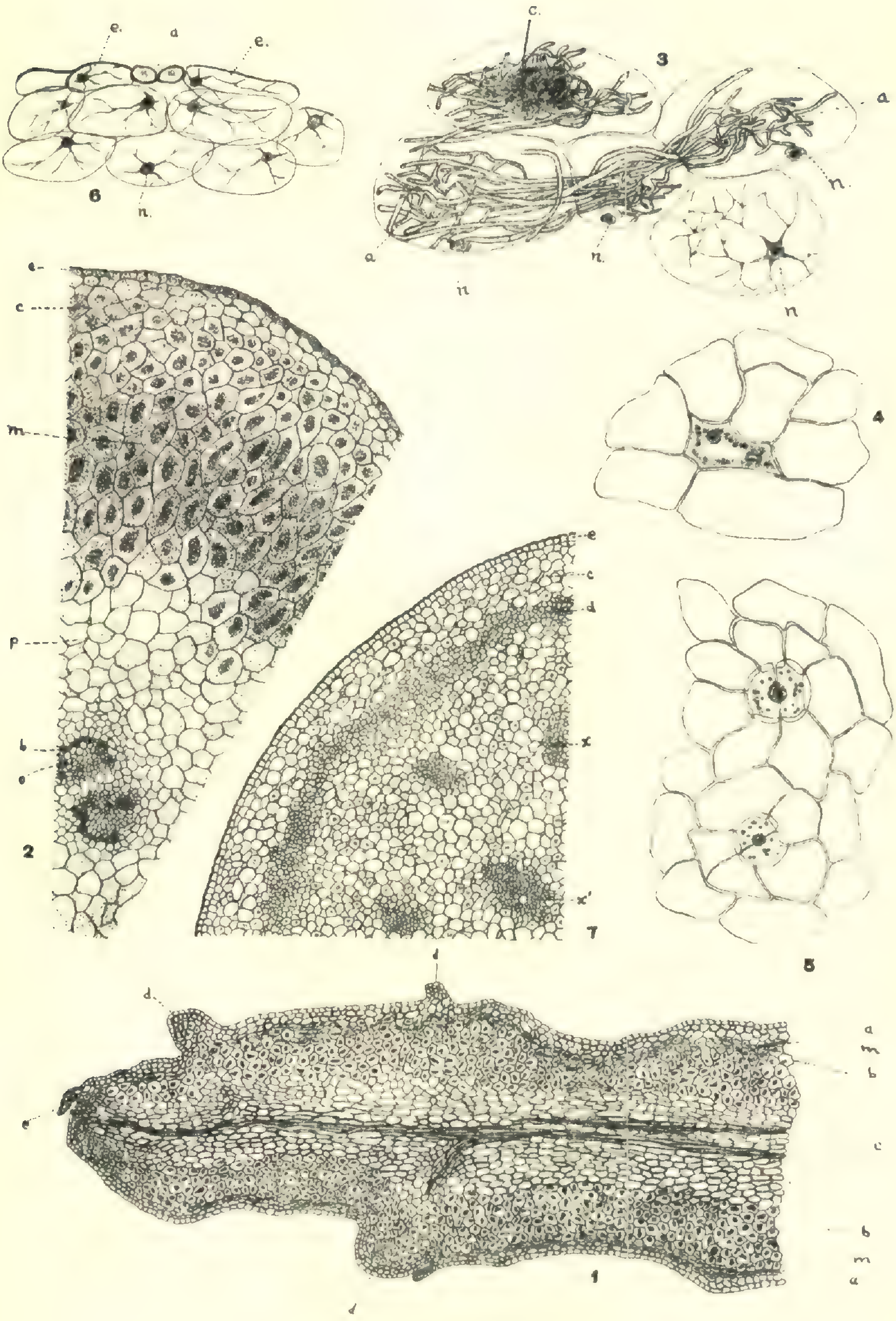
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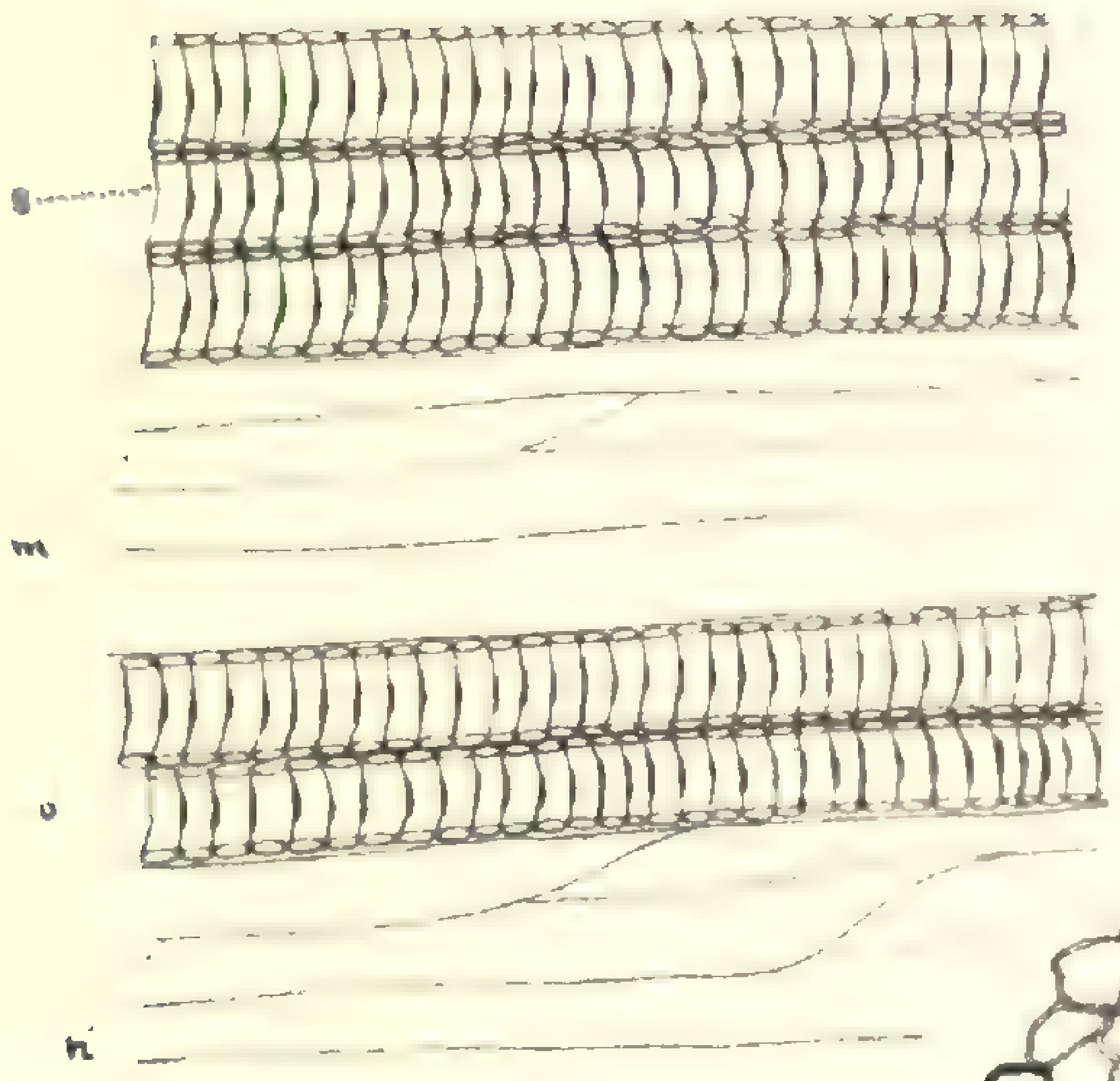

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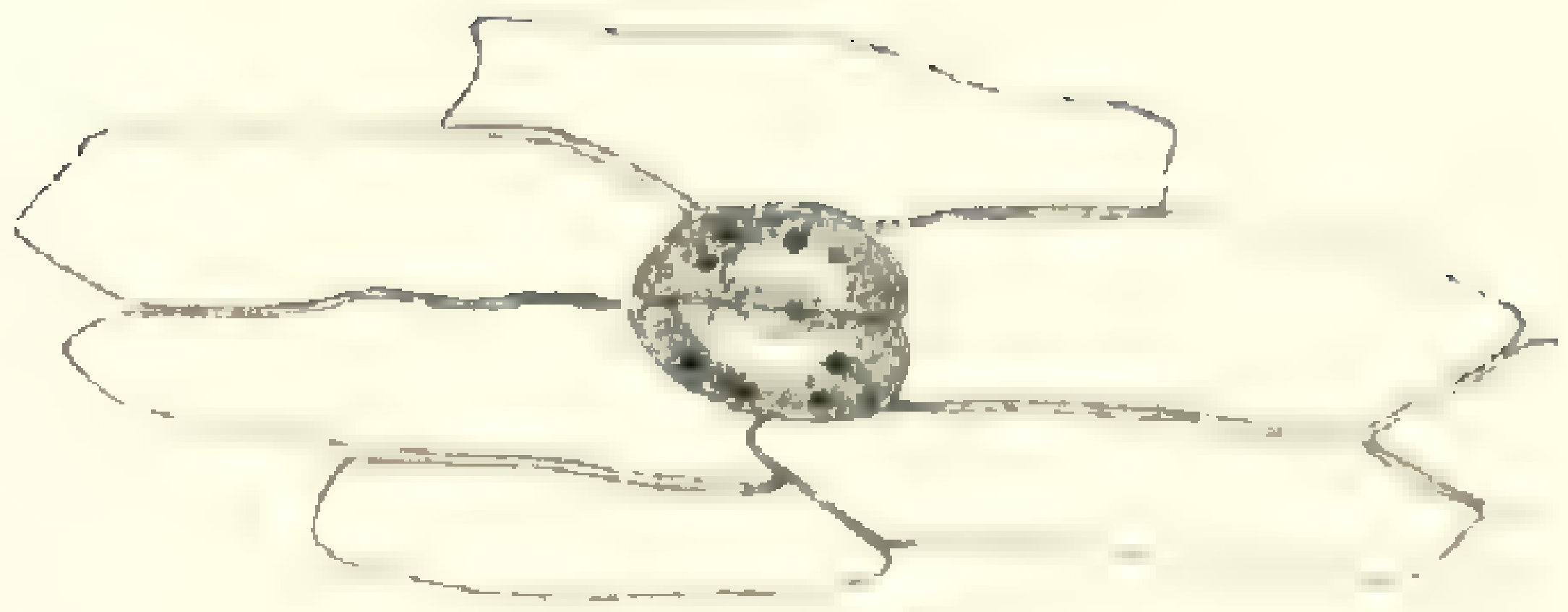

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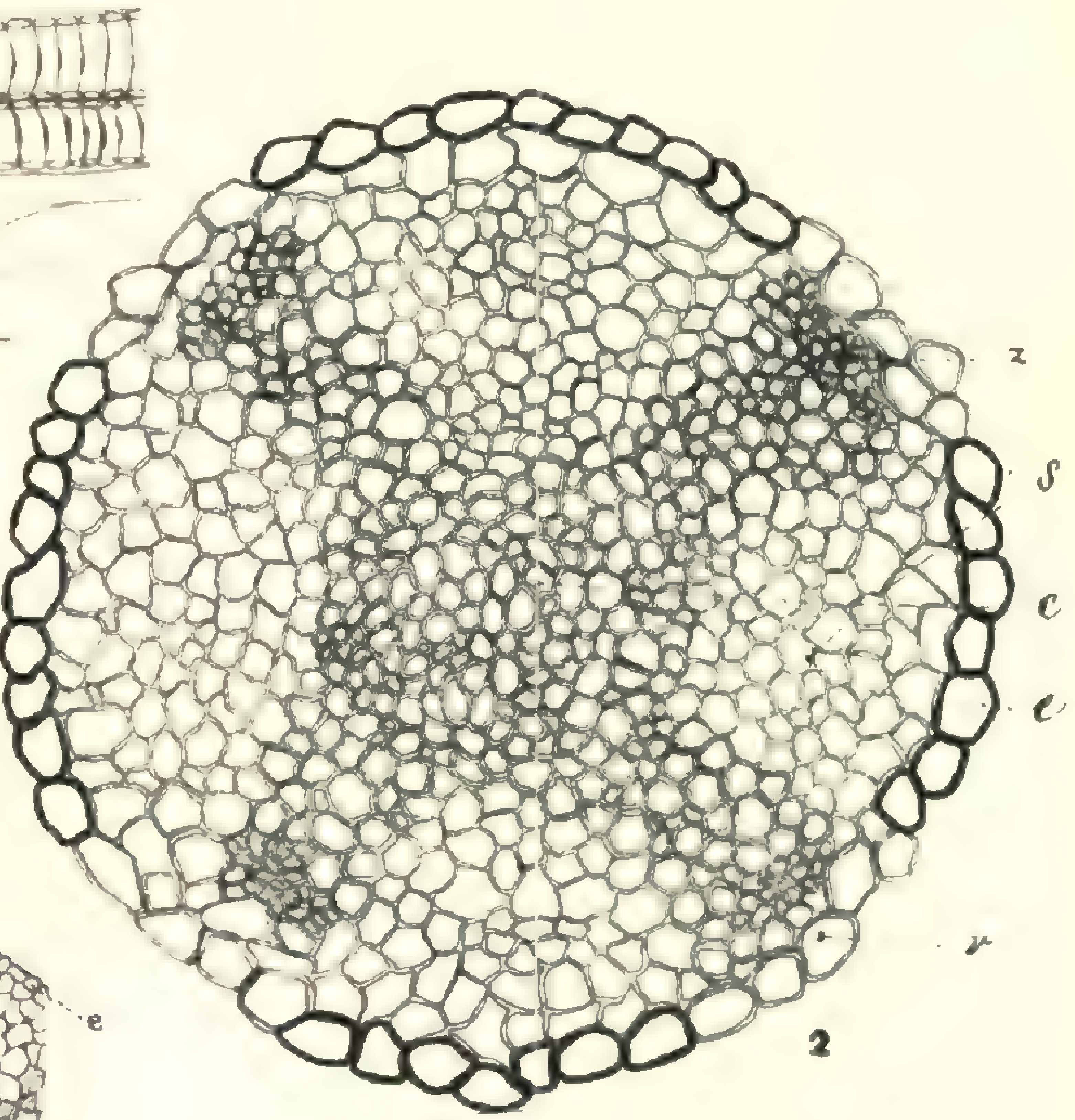

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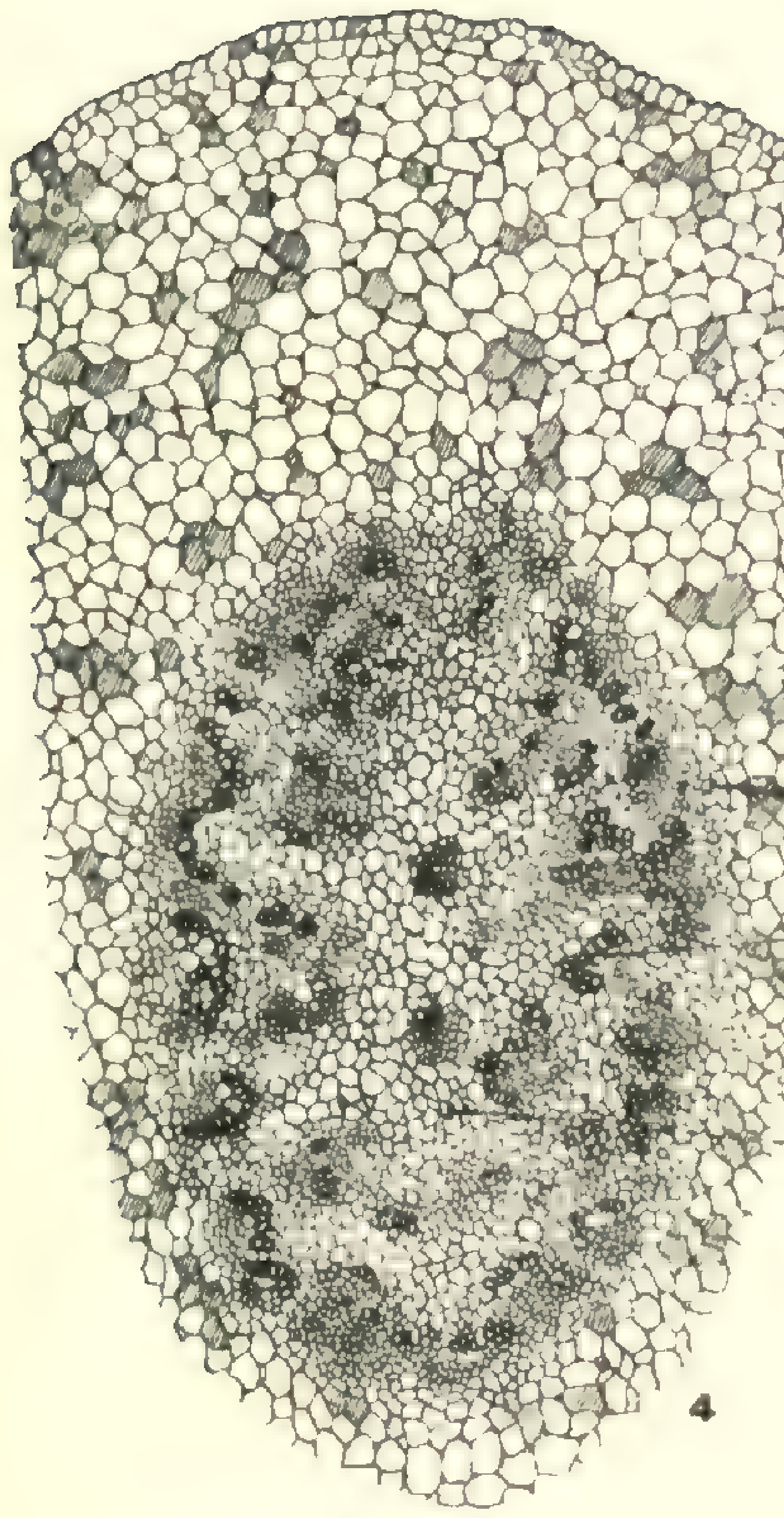

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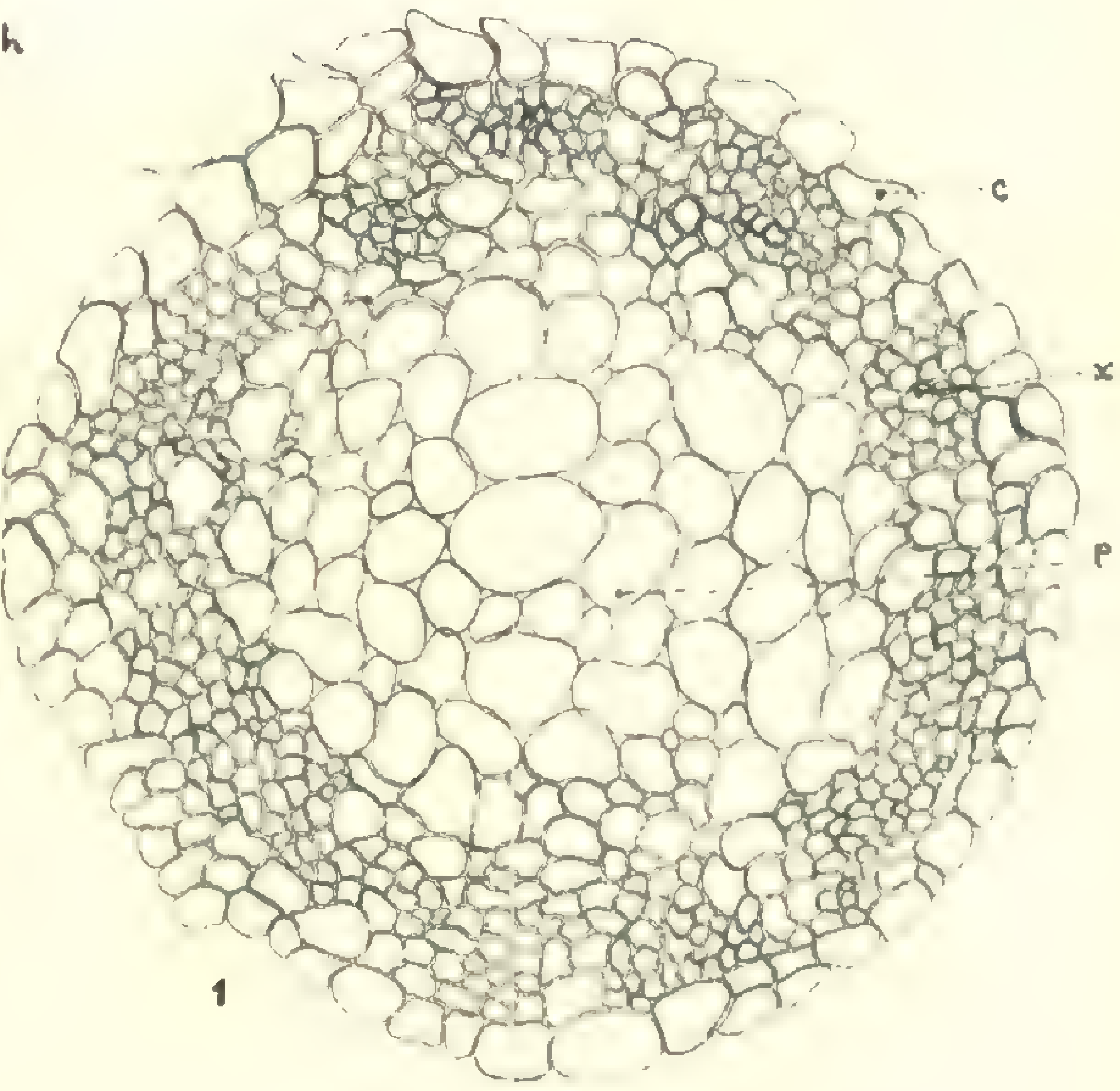

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VOL. 27 NO. 11

BULLETIN
OF THE
TORREY BOTANICAL CLUB

NOVEMBER 1899

Two hitherto confused Species of Lycopodium

BY FRANCIS E. LLOYD

[PLATE 370]

While botanizing during the past summer in southern Vermont in company with Dr. Marshall A. Howe, it was our fortune to come across, in an open sloping pasture, an extensive growth of a *Lycopodium*, which heretofore has been, in this country, referred to the variety *chamaecyparissus* of *L. complanatum*. Associated with it, and also growing in abundance was *L. complanatum*, and the very great difference in the appearance of the two plants, both as to color and habit, at once attracted our attention. Further field observation revealed the fact that the so-called variety differed from *L. complanatum* in several important details both morphological and physiological, the position of the rhizome among others. In *L. complanatum* this runs along the surface of the ground and is flattened above, develops chlorophyll in response to its exposed position, and has narrow leaves which curve upwards, while the rhizome of *L. chamaecyparissus* is strictly underground, buried to a depth of 2–4 centimeters, a fact which Dr. Howe and I sufficiently verified by digging up the new rhizomatous growths out of the tough sod at the periphery of the area covered by the colony, and which I have myself verified in many individuals subsequently found near Cold Spring, Long Island. The rhizome of this plant is, moreover, supplied with lanceolate to ovate leaves which are contracted at the base, and is white, except when, as is sometimes the case, the plant is forced out of its normal direction by hard

[Issued 15 November.]

obstacles, thus becoming exposed to the light. This difference of habit in respect to position was also recorded by C. F. Austin in a note in his writing attached to the sheet upon which is mounted a specimen of *L. chamaecyparissus* collected by him in Bergen county, New Jersey.

Another very pronounced and quite constant difference is the habit, on the part of *L. chamaecyparissus*, of producing annual growths at the ends of the branchlets. These new growths are more or less orthotropic, according as the habitat is exposed or shaded, and usually make angles with the earlier growth. This is especially noticeable as the aërial stems of the plant are frequently long and weak, allowing the weight of the foliage, which is often great, to force them out of their original vertical position, to make angles with the previous years' growths. There is thus produced a curious and distinctive habit which is in marked contrast with that of *L. complanatum* in which the branchlets are plagiotropic, and do not produce annual innovations except very occasionally, and then only short imperfect growths, which cannot at all be compared with the vigorous unfailing annual growth of *L. chamaecyparissus.*

Correlated with the more vertical habit of *L. chamaecyparissus* is the less pronounced dorsiventral character of the more distal branches and the similarity in form of their leaves. Here the leaves of the morphological under side of the branches are scarcely different in their amount of development from those of the upper side, while in *L. complanatum* they are so reduced that only their apices, abruptly spreading from the concave lower side of the branchlet, remain in evidence. This spreading character is common to all the leaves of *L. complanatum* while in *L. chamaecyparissus* the apices of the leaves of the lateral and under rows are appressed, so much so that those of the leaves of the lateral rows curve in underneath the flattened lower side of the branchlet.

In addition to these external leaf characters is to be added the glaucous character of *L. chamaecyparissus*, as compared with the absence of this character in *L. complanatum.* I have noticed that specimens of the former plant keep their moisture some time longer than do specimens of the latter, though I cannot give precise data on this point.

Nor are the differences wholly confined to the external and therefore more readily observable features, for an examination of transverse sections of the branchlets shows that the parenchyma beneath the lower epidermis is made up in *L. chamaecyparissus* of elongated cells of columnar form with oblique ends, similar but a little broader than those beneath the upper epidermis. This similarity in tissue is carried also into the epidermis, the cells of which, both on the upper and lower sides are nearly of the same size and have lumina of equal proportions. In *L. complanatum*, however, the parenchyma of the lower part of the branchlet is made up of globular cells, while those above are columnar. Here, too, we find that the cells of the upper epidermis have lumina much more reduced than do those of the lower. (Pl. 370, figs. 9, 10, 11 and 12.) The sclerenchyma sheath is also more strongly developed in *L. chamaecyparissus.*

Furthermore, there is a disparity in the time at which the spores ripen, a fact also not unnoticed by Austin, who records that in Bergen county, New Jersey, the spores of *L. chamaecyparissus* ripen "from one to two months earlier than in the type" that is, *L. complanatum.* Even in Vermont, where such phenomena are compassed in a shorter time, and where these observations were made, there is a difference of at least three weeks to a month in the time of spore-ripening. This fact must be one of considerable importance.

In the light of the above facts it seems strange that these two plants have been regarded by several botanists as not deserving of separate specific rank, though it is interesting to know that the veteran Alexander Braun so regarded them and that Dillenius* fully appreciated their differences, as is evidenced by his excellent figures. It appears from descriptions and specimens that the two plants are found abundantly in Europe and have been repeatedly observed growing together. In this connection Luerssen† observes: "The two plants (*i. e.*, *L. complanatum* and var. *β chamaecyparissus*) in these extreme forms appear so different, that they might well be regarded as distinct species. They pass, gradually, however, through intermediate forms, from one to the other." This experience seems, however, not to be dupli-

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*Hist. Musc. pl. 59 (*L. complanatum*) and 60 (*L. chamaecyparissus*). 1741.

†Rabenhorst, Kryptogamen-Flora. Farnpflanzen, 1: 825.

cated on this side of the Atlantic, for a careful search over an acre of ground in which a large number of colonies of both species were growing together, often intermixing, failed to discover anything at all to support this view. The two plants, growing on the same spot with their rhizomes crossing, were completely distinct. It would be of value if the botanists of this country to whom the opportunity may come, would make observations bearing on this matter. It may be added that certain European botanists appear to entertain no doubt as to the specific distinction of the two plants.

The attempt was made by the writer to find what differences, if any, existed between the spores, but without any very positive results. The spores of European specimens as well as from the United States were examined, and as much variation appears to exist between individual spores of *L. complanatum*, as between the spores of *L. clavatum* and either of these here under consideration. On the whole, however, there is a larger unreticulated area on the inside facets of the spores of *L. chamaecyparissus*, while the angles of the reticulations appear to be thickened in *L. complanatum*. I have not, however, been able to apply these criteria with unfailing certainty, so that I hesitate to assert that any value should be attached to them. There are slight differences, also, in the shape of the sporophylls, which in *L. chamaecyparissus* are usually more abruptly contracted beneath the apex than in *L. complanatum*.

LYCOPODIUM CHAMAECYPARISSUS A. Br.

Rhizomes extensively creeping 2–4 cm. below the surface of the ground, occasionally forced by obstructions to grow upward, but turning down again when the obstruction is passed, in color white, terete, sparingly branched in the horizontal plane, their whorled or loosely spirally arranged leaves lanceolate or ovate to broadly ovate (1–2 mm. broad), usually the latter, and then scarious, abruptly contracted into a narrow base, acute, their margins membranous and erose; the primary aërial shoots weak, terete, usually sinuously bent and often becoming decumbent under the weight of the superadded foliage, the axis repeatedly forking until it forms a mass of more or less vertically placed somewhat flattened branchlets which are plano-convex in transverse section, 1.5–2 mm. broad (concave beneath on drying); the terminal branchlets regularly producing more or less orthotropic innovations the second and sometimes the third season, the lower and therefore older foliage branches ultimately spreading and becoming lax, some of the medially placed branches remaining short, thicker, terete, strictly vertical, and producing either additional foliage parts or ultimately running up into strobile-bearing peduncles: leaves of the primary aërial axis in 6–8 rows, those at the base of the shoot similar to those of the rhizome, appressed, passing higher up the axis from ovate through lanceolate-acute into the acuminate form; those of the subterminal and terminal branchlets in four rows, an upper, an under and two lateral, glaucous, bluish green, acuminate, appressed, those of the under row differing scarcely at all from those of the other three rows, the leaves of the lateral rows somewhat incurved underneath, all becoming shorter and more crowded towards the end of the season's growth: peduncles terete, glaucous, 50–60 mm. long to the first forking, usually twice forked, the second 8–18 mm. distant from the first, spreading and curving upward, the leaves on the peduncle and its branches spirally scattered or less commonly loosely segregated into whorls of threes, spreading-acuminate, scarious-tipped; strobiles, two, three or usually four, 20–28 mm. long, the sporophylls broadly depressed ovate, truncate at the base, the lateral margins variously toothed, suddenly contracted into a subulate scarious tip; sporangium reniform, opening by a transverse slit along the top; spores deep yellow in mass, regularly areolate on the convex face, the areolae on the triangular inner faces becoming larger, more irregular and fading away so as to leave a triangular smooth area in the internal angle, ripening early in August. (*f. 2, 3, 6, 8, 11, 12, 16, 17.*)

The aërial parts reach a maximum height of about 22 cm. exclusive of the spore-bearing parts which project an additional height of 5–7 cm. above the general level of the foliage. The color is light bluish green, and glaucous throughout except on the aged lower branches, from which the waxy layer is worn away.

Found by Dr. M. A. Howe and myself growing on a sunny slope, where the plants made very dense masses of foliage with vertically placed branchlets. Newfane, Vt., July–August, 1899. Specimens found later (Oct. 14, 1899) by myself, on the hills near Cold Spring Harbor, Long Island, N. Y., which were growing in the shade, and which were very much less vigorous than the Vermont material, have looser foliage, the branchlets of which do not stand vertically, though they do turn upward at the ends, and the innovations grow upward. The variation in position may be regarded as a response to different light influences. This series also includes a single weak plant with widely spreading leaves, curiously mimicking a seedling of *Juniperus Virginiana*. The above material is all in the herbarium of the New York Botanical Garden.

Other herbarium material has been examined as follows :*

CONNECTICUT: New Haven, 1858, *D. C. Eaton* (GC.).

DELAWARE: near Iron Hill, Aug. 21, 1894, *A. Commons and E. Tatnall* (C.). Latrobe Canal feeder, 2 miles west of Iron Hill, Aug. 5, 1895, A. Commons (G.).

DISTRICT OF COLUMBIA, July, 1879, *L. F. Ward* (N.).

GEORGIA: Tallulah Falls, Apr. 19, 1891, *L. M. Underwood*, no. 2550a (U.).

MAINE: Mt. Desert, Sept. 5, 1891, *T. G. White* (C.). Mt. Desert Island, July 9, 1890, *John H. Redfield* (U.). Aroostook Co., St. Francis, dry woods, Aug. 9, 1895, *M. L. Fernald*, no. 217 (C. N. G. U.). Orono, "dry woods," Oct. 13, 1890, *M. L. Fernald* (G.).

MARYLAND: Bladensburg, July 20, 1879, *L. F. Ward* (U.); 1880, *L. F. Ward* (N.).

MASSACHUSETTS: Essex Co., *Oakes* (C.).

MICHIGAN: Near Alpena, July 11, 1895, *C. F. Wheeler* (G. N. C.). Sand dunes, Lake Huron, Huron Co., Aug. 5, 1896, *Charles A. Davis* (N.). Keweenaw Co., *Robbins* (G.). Keweenaw Co., "woods and fields," Aug., 1890, Sept., 1889, *O. A. Farwell*, no. 746 (G.).

MINNESOTA: Lake Kilpatrick, Caseo Co., July, 1893, *C. A. Ballard* (N.).

NEW HAMPSHIRE: "old clearings," Jaffrey, July 15, 1897, *B. L. Robinson* no. 225 (G.).

NEW JERSEY: Bergen Co., *C. F. Austin* "stems running rather deep (2–4 inches) in the ground. Of a more slender habit and generally with more numerous spikes than the typical form from which it is readily distinguished when they grow side by side by its shedding its spores 1–2 months earlier (in Aug.) and by its spikes turning saffron yellow. I have never found it except in shady places" (G.).

---

* The letters C, G, N, U and Y indicate the Columbia, Gray, National, Underwood and New York Botanical Garden herbaria, where the cited specimens may be consulted.

NORTH CAROLINA: mountains, Waynesville, Sept. 1896, *S. M. Huger* (C.).

PENNSYLVANIA: Tobyhanna, Pocono Mt., Aug. 20, 1887, *N. L. Britton.* (C.).

VIRGINIA: Clifton, Oct. 12, 1884, *L. F. Ward* (U.).

LYCOPODIUM COMPLANATUM L.

Rhizomes extensively creeping along the surface of the ground, exposed or in moss, etc., usually green, flattened above, furrowed on the flattened surface, sparingly branching in the horizontal plane, spirally arranged or sometimes loosely segregated in whorls: their leaves lanceolate, acuminate, scarious-tipped, the lateral ones curving upward; primary aërial shoots strong, flattened and furrowed on one side, the branches convex on the upper side, concave below (1.8–2.5 mm. broad), spreading out into a horizontal plane, the medially placed branches more nearly terete, and either producing additional foliage-bearing shoots or, ultimately, sporangium-bearing peduncles: leaves of the vertical axes spirally placed or in loose whorls, spreading, acuminate, scarious-tipped, the several (5–8) rows being reduced to four on the foliage branches; the leaves of the upper and lateral rows, which are separated as by a continuous furrow, cuspidate, with spreading apices, bright green, those of the under row reduced to slender, curved, spreading, cuspidate apices, the under side of the branchlets thus appearing devoid of foliage, lighter in color and concave; all the leaves decreasing gradually in size from the base to the tips of the branches: peduncles (5–7.5 cm. long up to the forking) terete, a little stouter than in *L. chamaecyparissus*, furrowed, forking usually twice, the first and second forks 2–5 mm. distant from each other: pedicels straight, 5–8 mm. (mostly 7–8 mm. long), bearing strobiles 15–25 mm. long: leaves of the peduncles and pedicels scattered or loosely whorled in threes, acuminate, scarious-tipped, spreading: sporophylls broadly ovate, more or less toothed on the lateral margins, contracted gradually into a scarious apex: sporangia reniform, opening by a transverse slit: spores reticulate on the four faces, ripening late in August and in September. (*f. 1, 4, 5, 7, 9, 10, 13, 14, 15.*)

CONNECTICUT: West Goshen, Aug., 1889, *L. M. Underwood* C. U.). Greens Farms, Aug. 25, 1894, *C. L. Pollard*, no. 233. An abnormal condition with asporogenous spikes (N.). Derby, July 7, 1895. "Dry woods, common," *E. H. Eames, M.D.* (N.).

DISTRICT OF COLUMBIA: Near the Sligo, north of Takoma, July 10, 1895, *C. L. Pollard*, no. 467 (N.).

INDIANA: Fern, Putnam Co., Oct., 1892, *L. M. Underwood* (U.).

MAINE: Anson, July 9, 1885, *T. F. Collins*, "Fertile" (G.).

MASSACHUSETTS: Essex Co., *William Oakes* (C.). Mt. Toby, near Amherst, July 27, 1895, *Mrs. A. F. Stevens* (N.); 1871, *Dr. Palmer* (N.). Benjamin Hill, near Winchendon, Worcester Co., Sept. 3, 1895, *C. L. Pollard* (N.). Concord, "woods around Walden Pond," Sept. 30, 1879, *W. P. Rich* (G.). Concord, Nov. 1, 1890, *L. M. Underwood* (U.). A form with six strobiles on the peduncle and more distant forkings, Northfield, July 5, 1890, *F. E. Lloyd* (Y.). Williamstown, Oct., 1891, *F. E. Lloyd* (Y.).

MARYLAND: near Signal Tree Heights, between Washington and Silver Spring roads, Oct. 7, 1893, *Adam Steitz* (N.). Spencerville, July, 1891, *J. M. Holzinger* (N.).

MINNESOTA: Soudan, St. Louis Co., 1896, *J. H. Ely* (C.). Duluth, July 26, 1889, pine woods, 16 miles west of Duluth (N.).

NEW HAMPSHIRE: southern "woods common," July 9, 1897, *B. L. Robinson*, no. 187 (G.). Seabrook, 1894, *Alvah Eaton* (with abnormal forking spikes) (U.). Benton, July 4, 1890, *S. F. Tower*.

NEW JERSEY: Clifton, Sept. 23, 1894, *T. H. Kearney, Jr.* (C.). Bergen Co., "matures its spores in September and October," *C. F. Austin* (C.). Bergen Co., "a variety with short rigid leaf-branches and numerous short spikes," *C. F. Austin* (C.). Stockholm, "swamp, 1100 ft. alt.," Aug. 1–15, 1895, *Wm. M. Van Sickle* (N.).

NEW YORK: Tannersville, Greene Co., Oct. 6, 1891, *A. M. Vail* (C.). "Dry copse, near woodland, common," Nov. 28, 1890, *R. Kenyon* (N.). Cold Spring Station, Long Island, in deep woods, Oct. 14, 1899, no spikes found, *F. E. Lloyd* (Y.). Morrisville, Oct., 1878, *L. M. Underwood* (U.). West Camden, 1897, *Arma A. Smith* (U.).

ONTARIO: Gun Flint Lake, July 18, 1891, *F. F. Wood* (N.).

PRINCE EDWARD ISLAND: Cantire, Sept. 3, 1883, *John Macoun* (C.).

QUEBEC: Notre Dame du Lac, Termiscouata Co., Aug. 2, 1887, *John I. Northrop* (C.).

VERMONT: Willoughby Lake, Aug. 22, 1895, *Mrs. G. F. Stevens* (N.); Willoughby, July 26, 1892, *H. H. Rusby* (C.); Newfane, July–Aug., 1899, *M. A. Howe and F. E. Lloyd* (Y.).

WEST VIRGINIA: South Fork of Holston River, Smyth Co., June 15, 1892, *N. L. and E. G. Britton and A. M. Vail* (C.).

Explanation of Plate 370

The figures were drawn from specimens collected near Newfane, Vt., growing in the same habitat. Figures 3–8 were drawn to the same scale × 9, as were also figures 9–12 and 13–17.

FIG. 1. *Lycopodium complanatum;* upper part of aērial shoot bearing two peduncles, only one of which is shown. × ⅔.

FIG. 2. *Lycopodium chamaecyparissus;* upper part of aērial shoot. In this particular plant the peduncle does not extend as far as it does normally above the general level of the foliage. The terminal branchlets can be seen to make definite angles with the subterminal, previous year's growth. × ⅔.

FIGS. 3, 6, 8. Upper, under and lateral views respectively, of a part of a branchlet of *Lycopodium chamaecyparissus.*

FIGS. 4, 5 and 7. Upper, under and lateral views respectively, of a part of a branchlet of *Lycopodium complanatum.*

FIGS. 9 and 10. Portions of the epidermis and subjacent parenchyma from the upper and under sides respectively, of a branchlet of *Lycopodium complanatum.*

FIGS. 11 and 12. The same of *Lycopodium chamaecyparissus.*

FIGS. 13 and 14. Outlines of scales from the rhizome of *Lycopodium complanatum.*

FIG. 15. Sporophyll of *Lycopodium complanatum.*

FIG. 16. Sporophyll of *Lycopodium chamaecyparissus.*

FIG. 17. Half-outlines of scales from the rhizome of *Lycopodium chamaecyparissus.*

The dichotomous Panicums; Some new Species.—I

By Geo. V. Nash

Panicum Bushii

A tufted perennial, glabrous, with the exceptions noted below. Culms about 3 dm. tall, the nodes sparingly barbed, finally much branched: leaves about 3; sheaths about as long as the internodes, those on the branches short and overlapping; ligule a dense ring of short hairs about 0.2 mm. long; blades erect, linear, acuminate, serrulate and very rough on the margins, ciliate at the base with a few very long hairs arising from papillae, the larger primary blades 8–10 cm. long, 3–4 mm. wide, those on the branches usually 6 cm. or less long: panicle much exserted, 6–7 cm. long, its branches erect-ascending, the larger 3–3.5 cm. long, the secondary panicles much smaller: spikelets 2.5 mm. long and about 1.2 mm. broad, obovate, the scales glabrous, the first scale orbicular or very broadly ovate, 1-nerved, rounded or obtuse at the apex, about one-third as long as the spikelet, the second and third scales 7-nerved, the second a little the shorter, the fourth scale yellowish white, about 2 mm. long and 1.2 mm. wide, about as long as the second.

Collected by B. F. Bush, in dry ground, in McDonald Co., Missouri, July 24, 1893 no. 413. Related to *P. augustifolium*, but the spikelets are glabrous and of a different shape and the sheaths and blades glabrous.

Panicum ciliosum

A tufted perennial. Culms 3–5 dm. tall, rather stout, ascending, papillose-hirsute with spreading hairs, finally much branched: leaves 4 or 5; sheaths shorter than the internodes, densely hirsute with spreading hairs, ciliate on the margins; ligule a dense ring of hairs about 0.5 mm. long; blades erect or ascending, narrowed toward the base, glabrous above, ciliate on the margins, the stiff hairs arising from papillae, the lower surface densely pubescent between the nerves with short spreading hairs: panicle broadly ovate, about 8 cm. long, included at the base, its axis pubescent with short hairs, the branches spreading, the larger about 3 cm. long: spikelets a trifle less than 2 mm. long and about 0.9 mm. wide, elliptic, the outer 3 scales strongly pubescent with rather long spreading hairs, the first scale broader than long, about one quarter as long as the spikelet, 1-nerved, rounded at the apex, the second and third scales 7-nerved, about equal in length, the fourth scale white, a little longer than the third, about 1.6 mm. long and 0.8 mm. wide.

Type collected by S. M. Tracy, at Biloxi, Mississippi, September 1, 1898, no. 4580. In habit and general appearance much resembling *P. pubescens*, but the ciliate blades with the upper surface glabrous at once separate it. The specimen above described is the late state and has the panicle included; the early form of the plant will probably be found to have an exserted primary panicle.

Panicum Clutei

A tufted perennial, glabrous, with the exceptions noted below. Culms rather stout, 6–8 dm. tall, at length branched: leaves 4 or 5; sheaths rather loose, minutely pubescent at the apex and usually more or less ciliate on the exterior margin, the exterior basal ones pubescent; ligule a dense ring of hairs about 0.3 mm. long; blades firm, ascending, often appearing as if erect in pressing, lanceolate, smooth on both surfaces, rough on the margins, the lower and larger 7–14 cm. long, 7–12 mm. wide, the basal blades ovate-lanceolate, 3–4 cm. long and 10–13 mm. wide, long-ciliate on the margins: panicle considerably exserted, broadly ovate, 6–10 cm. long, its ascending branches smooth, the larger ones 4–6 cm. long: spikelets oval, acutish, about 2.3 mm. long and about 1.3 mm. wide, the first scale broadly ovate, obtuse or somewhat acute, 1-nerved, glabrous or nearly so, the second and third scales densely pubescent with very short ascending hairs, 9-nerved, the second one shorter than the third and usually a little shorter than the fourth, the fourth scale yellowish, oval, about 2 mm. long and about 1.2 mm. wide.

Pine-barrens of southern New Jersey. Collected by Mr. W. N. Clute, after whom I take pleasure in naming it, on a trip from Tuckerton to Atsion, July 3–6, 1899. A most distinct species.

Panicum curtifolium

A tufted perennial, glabrous, with the exceptions noted below. Culms slender, weak, 2–3 dm. tall, finally much branched: leaves 3 or 4; sheaths less than one half as long as the internodes, usually about one third as long, sparsely pubescent with long weak spreading hairs; ligule a dense ring of hairs about 0.3 mm. long; blades widely spreading, lanceolate, minutely serrulate and rough on the margins, a few long hairs on the upper surface just back of the ligule, the culm blades 1.5–3 cm. long, 3–4.5 mm. wide, the basal leaves 4–5 cm. long: panicle considerably exserted, broadly ovate, 2.5–3.5 cm. long, its slightly hispid branches widely spreading, the larger 1.5–2 cm. long: spikelets about 1.5 mm. long and about 0.75 mm. wide, elliptic, the scales glabrous, the first scale about one third as long as the spikelet, broadly ovate, obtuse, 1-nerved, the second and third scales 7-nerved, the second shorter than the third, the fourth scale about equalling the third, about 1.25 mm. long and about 0.6 mm. broad, yellowish-white, obscurely apiculate.

Collected by S. M. Tracy at Ocean Springs, Mississippi, May 2, 1898, no. 4598. Related to *P. lucidum* Ashe, but distinguished by its smaller spikelets and sparsely pubescent sheaths.

Panicum decoloratum

A more or less purplish tufted perennial, glabrous, with the exceptions noted below. Culms 4–6 dm. tall, stout, finally branched, the nodes barbed: leaves 5 or 6, extending to the base of the panicle, the upper one including its base; sheaths loosely embracing the culm, usually overlapping and hence concealing the culm, the lower and basal ones papillose-hirsute between the nerves, the hairs of the former early deciduous, the upper sheaths ciliate on the external margin and with a minutely pubescent ring at the apex; blades erect or ascending, variously colored with black-purple, broadly lanceolate, a little rough on both surfaces, especially above, cordate-clasping at the base, 7–12 cm. long, 1.2–2 cm. wide, minutely serrulate and very rough on the margins: panicle included at the base, its branches hispidulous: spikelets on hispidulous pedicels, 2.7 mm. long and 1.3 mm. wide, elliptic, the first scale from nearly orbicular to broadly ovate, about one third as long as the spikelet, 1-nerved, obtuse or rounded at the apex, glabrous, the second and third scales rather sparingly pubescent with ascending hairs, 9-nerved, the second scale a little shorter than the third, the fourth scale slightly yellowish-white, about 2.4 mm. long and 1 mm. wide, obtusely and rather obscurely apiculate, minutely pubescent at the apex.

Collected by Mr. E. P. Bicknell on a sandy railroad bank at Tullytown, Pennsylvania, May 30, 1899. The panicle in the material at hand may not be fully developed, and so a later stage may show it exserted instead of included at the base. In habit much resembling *P. clandestinum*, but that species is larger in every way, the pubescence is harsh and hispid and occurs on all the sheaths, the blades are much longer and with the margins near the base conspicuously ciliate with long stiff hairs, and the spikelets are larger (exceeding 3 mm. in length).

Panicum Earlei

A densely tufted perennial. Culms slender, 1–1.5 dm. tall, usually with a few long weak scattered hairs below, finally branched, the nodes rather sparingly barbed: leaves about 3; sheaths rather sparingly hirsute with long hairs; ligule a dense ring of hairs about 0.3 mm. long; blades ascending, lanceolate, rather sparingly hirsute on both surfaces with long spreading hairs, 1–3 cm. long, 2–6 mm. wide, minutely serrulate and roughened on the margins: panicle broadly ovate, 2–3 cm. long, its smooth branches spreading, the larger ones 1–1.5 cm. long: spikelets about 1.3 mm. long and 0.7 mm. wide, elliptic, obtuse, glabrous, the first scale orbicular or broadly oval, 1-nerved, obtuse, the second and third scales 7-nerved, the second scale shorter than the third and fourth, the fourth scale white, about 1 mm. long and 0.6 mm. wide, oval.

Type collected at Auburn, Lee Co., Alabama, on May 7, 1898, by Messrs. F. S. Earle and C. F. Baker, no. 1532; no. 1535, of the same place and date, also belongs here.

Panicum epilifolium

A tufted perennial, glabrous, with the exceptions noted below. Culms 2–3.5 dm. tall: leaves 2 or 3; sheaths shorter than the internodes, minutely pubescent at the apex, ciliate on both margins with long slender hairs; ligule a scarious ciliolate ring about 0.2 mm. wide; blades widely spreading, linear-lanceolate, 4–7 cm. long, 5–7 mm. wide, minutely pubescent on the upper surface between the nerves, serrulate and very rough on the margins: panicle exserted, ovate, 5–7 cm. long, its branches spreading or ascending, the larger ones 2–2.5 cm. long: spikelets 3 mm. long and about 1.5 mm. broad, oval, obtusely apiculate, the first scael glabrous or with a few scattered hairs, 1-nerved, nearly orbicular, acute, a little less than one half as long as the spikelet, the second and third scales densely pubescent with short spreading hairs, 9-nerved, the second usually a little shorter than the third and fourth, the latter scale yellowish, 2.5 mm. long and a little over 1 mm. wide, elliptic, obtusely apiculate.

Type collected by the writer in a scrub hammock at Eustis, Lake Co., Florida, March 12–31, 1894, no. 45. Also secured at the same place by Professor L. M. Underwood, on March 22, 1891, no. 2250. It bears some resemblance in habit to *P. ciliiferum*, but is readily distinguished from that species by its glabrous sheaths, naked blade-margins and more acute spikelets.

Panicum flavovirens

A densely tufted light green perennial, glabrous, with the exceptions noted below. Culms 2–3 dm. tall, slender, finally much branched: leaves 2 or 3; sheaths very short, those of the primary leaves about one third as long as the internodes, one margin usually extending above the other, making the summit of the sheath more or less oblique, the lower sheaths ciliate on the margin, the exterior basal ones pubescent all over; ligule a dense ring of short hairs about 0.2 mm. long; blades thin, erect, without a white margin or nearly so, entire or very minutely serrulate, hence smooth or nearly so on the margin, linear-lanceolate, those on the main culm 2.5–4 cm. long, 2.5–4 mm. wide, commonly minutely pubescent on the lower surface between the nerves, those on the branches much shorter, the basal blades longer, 4–6 cm. long: panicle much exserted, 3–4 cm. long, broadly ovate, its branches spreading, the larger 1–2 cm. long, the secondary panicles much smaller, barely exserted and with spreading branches: spikelets 1.5 mm. long and 0.7 mm. broad, elliptic, the outer 3 scales densely pubescent with spreading hairs, the first scale 1-nerved, broadly ovate, obtuse, about one half as long as the spikelet, the second and third scales 7-nerved, about equal in length, the fourth scale yellowish-white, 1.3 mm. long and about 0.6 mm. wide.

Type collected by the writer in Lake Co., Florida, June 16–30, 1895, no. 2061; growing in swampy woods along the edge of road leading to the ford near the J. T. & K. W. R. R. bridge across the Wekiva river. No. 2487a, collected in a similar habitat at Lake City, Columbia Co., in the same state, on Aug. 30, 1895, is also referred here.

Differs from *P. albomarginatum* in the thin linear-lanceolate blades which are entirely or almost devoid of the white margin, and barely if at all rough on the margins. In *P. albomarginatum* the blades are very thick, much broader, and with a wide strongly serrulate white margin which is much thickened.

Panicum Helleri

A tufted perennial, glabrous, with the exceptions noted below. Culms 2–4 dm. tall, appressed-pubescent below with long hairs, the nodes sparingly barbed, finally branched: leaves 5; sheaths shorter than the internodes, the middle ones only about one half as long, ciliate on the exterior margin, bearing between the prominent nerves scattered papillae, from which sometimes arise stiff hairs, the internerves of all but the upper sheaths minutely pubescent: ligule a dense ring of hairs about 0.6 mm. long: blades broadly lanceolate, thin, a little narrowed toward the sparsely ciliate rounded base, the margins minutely serrulate, rough, 6–8 cm. long, 6–12 mm. wide: panicle included at the base, 6–8 cm. long, its branches ascending, the larger ones 3–4 cm. long, the secondary panicles smaller: spikelets 3.25–3.5 mm. long and about 1.5 mm. wide, the first scale broadly triangular-ovate, 1-nerved, the second and third scales pubescent toward the base with a few scattered hairs, the second scale 11-nerved, the third scale 9-nerved, the fourth scale yellowish-white, 2.5 mm. long and about 1.3 mm. wide, oval, obtusely and obscurely apiculate.

Collected at Kerrville, Kerr Co., Texas, by A. A. Heller, May 14–21, 1894, no. 1759. Differs from *P. pernervosum* in the pubescent culm and sheaths, the broader blades of a different shape and the narrow spikelets which are usually sparsely pubescent.

Panicum paucipilum

A tufted perennial, glabrous, with the exceptions noted below. Culms 6–10 dm. tall, finally sparingly branched: leaves 5–8; sheathes one third to one half as long as the internodes, the external margin ciliate toward the summit; ligule a dense ring of hairs about 2 mm. long: blades erect or ascending, thickish, rather firm, sometimes minutely puberulent on the lower surface, usually with a few hair-bearing papillae at the base, the lower and larger 6–9 cm. long, 5–7 mm. wide: panicle finally considerably exserted, rather dense, oblong, usually 5–10 cm. long, its branches erect-ascending or erect, the larger ones 2.5–4 cm. long: spikelets numerous, about 1.4 mm. long and 0.8 mm. wide, oval, the first scale about one third as long as the spikelet, 1-nerved, orbicular, the second and third scales pubescent with spreading hairs, the former plainly, the latter obscurely, 9-nerved, the fourth scale yellowish, about 1.3 mm. long and 0.8 mm. wide, obscurely apiculate.

In wet soil, southern New Jersey to Mississippi. Type collected by Mr. E. P. Bicknell, at Wildwood, New Jersey, May 30 and 31, 1897. The following specimens from Mississippi are also referred here:

Ocean Springs, July 19, 1889, F. S. Earle; Biloxi, Sept. 1, 1892, S. M. Tracy; Beauvoir, May 13, 1898, S. M. Tracy, no. 4594 (distributed as *P. octonodum* S. & S.).

Intermediate between *P. octonodum* and *P. Eatoni*. Differs from the former, to which it is closely related, in the ciliate margin of the sheaths, the few basal hairs of the blades, and particularly in the strongly pubescent spikelets. From *P. Eatoni* it may be distinguished by its much smaller spikelets with the first scale glabrous and orbicular.

Panicum longiligulatum

A tufted perennial, glabrous, with the exceptions noted below. Culms 4–5 dm. tall, slender, finally branching, the branches fasciculately much divided and forming dense masses at their ends; leaves 4 or 5; sheaths usually from one third to one half as long as the internodes, minutely pubescent between the prominent nerves; ligule a ring of long erect silky hairs about 3 mm. in length; blades ascending, lanceolate, obtusely and minutely pubescent on the lower surface, the margins serrulate and very rough, the primary culm blades 2.5–3 cm. long, about 3 mm. wide, those on the branches much smaller, the basal blades thick, broadly lanceolate, 4–5 cm. long: panicle oval, 5–6 cm. long, considerably exserted, its branches spreading, the larger ones about 3 cm. long: spikelets about 1.3 mm. long and 0.8 mm. wide, oval, the outer 3 scales densely pubescent with spreading hairs, the first scale ovate, 1-nerved, about one third as long as the spikelet, the second and third scales 7-nerved, about equal in length, the fourth scale yellowish white, about 1.2 mm. long and 0.7 mm. wide.

Collected by Dr. Geo. Vasey, at Apalachicola, Florida, in 1892. Its relationship is with *P. parvispiculum*, but its more slender culms, smaller blades and spikelets and the glabrous margins of the sheaths at once distinguish it.

Panicum patentifolium

A tufted purplish perennial, glabrous, with the exceptions noted below. Culms erect or nearly so, 2–4 dm. tall, puberulent, slender, finally much branched: leaves 2–4, rather distant; sheaths less than one half as long as the internodes, minutely pubescent, especially at the apex on the margins, rather loosely embracing the culm; ligule a dense ring of hairs about 0.25 mm. long; blades widely spreading, firm, lanceolate, 2.5–4 cm. long, 2–4 mm. wide, puberulent at the very base on the upper surface, smooth on both sides, rough on the margins, the basal ones similar in shape and texture but larger: panicle at length considerably exserted, broadly ovate, 4–6 cm. long, its axis and spreading branches puberulent, the larger branches 2–3 cm. long: spikelets about 2.5 mm. long and 1.3 mm. wide, the first scale orbicular, clasping, purple, at least at the base, 1-nerved, rounded at the apex, one half as long as the spikelet, the second and third scales pubescent with spreading hairs, 7-nerved, the fourth scale white, a little exceeding 2 mm. in length, oval, minutely pubescent at the apex.

Type collected by the writer at Eustis, Lake Co., Florida, March 12–31, 1894, no. 72, in dry sand in a scrub hammock. No. 52 of the same collection also belongs here.

Related to *P. Webberianum*, but the more slender culms and the smaller and widely spreading blades readily separate it.

Panicum perlongum

A tufted pubescent perennial. Culms 2–4 dm. tall, simple, glabrous or sparingly pubescent, the nodes barbed, later with short basal culms: leaves 1 or 2; sheaths hirsute with long ascending hairs; ligule a dense ring of hairs about 0.7 mm. long; blades elongated, linear, erect, papillose-hispid beneath, glabrous, rough above, 2–3 mm. wide, the upper blade commonly 8–14 cm. long, occasionally shorter: panicle much exserted, generally extending beyond the apex of the upper leaf, 4–6 cm. long, its branches erect or erect-ascending, the larger ones usually 2–3 cm. long: spikelets, on hispidulous pedicels, obovate, about 3.25 mm. long and 1.5–1.75 mm. wide, the outer 3 scales with a few scattered long hairs, especially near the base, the first scale one quarter to one third as long as the spikelet, orbicular-ovate, 1-nerved, the second and third scales 9-nerved, about equal in length, the fourth scale oval, 2.5 mm. long and about 1.5 mm. wide, yellowish white, obtusely apiculate, its summit reaching the apex of the third scale.

On prairies and dry soil, Illinois to North Dakota, south to Indian Territory. Type collected in Indian Territory at Creek Nation, by M. A. Carlton, April 25, 1891, no. 98, and distributed as *P. depauperatum* Muhl. It differs from that species in the smaller pubescent obtuse spikelets with the second and third scales not exceeding the fourth scale. From *P. linearifolium*, to which it is more nearly related, it is separated by its larger sparsely pubescent spikelets.

The following specimens, distributed as *P. depauperatum* Muhl., are also referred here:

ILLINOIS: June 7, 1848, *S. B. Mead.*

SOUTH DAKOTA: Custer, July 18, 1892, *P. A. Rydberg*, no. *1100.*

IOWA: Ames, June 22, 1896, *C. R. Ball*, no. *145.*

KANSAS: Prairie, Riley Co., 1896, *A. S. Hitchcock*, no. *881.*

Panicum pernervosum

A glabrous perennial. Culms 3–5 dm. tall, finally branching: leaves 3 or 4; sheaths ciliate on the exterior margin, the lower longer, the upper shorter than the internodes; ligule a dense ring of hairs about 0.5 mm. long; blades erect or ascending, narrowed toward the base, serrulate and very rough on the margins, the intermediate and upper blades 5–10 cm. long, 5–9 mm. wide, ciliate toward the base with a few long hairs, the lower ones usually pubescent on the lower surface, shorter and broader, ciliate for two thirds their length: panicle considerably exserted, 7–12 cm. long, its branches ascending, the larger ones 4–6 cm. long: spikelets 3 mm. long and 1.8 mm. wide, broadly oval, turgid, rounded at the apex, the scales glabrous, the first scale broader than long, 1-nerved, about one third as long as the spikelet, the second and third scales coarsely 9-nerved, the second a little shorter than the third, the fourth scale yellowish white, 2.5 mm. long and about 1.6 mm. broad, obtusely and rather obscurely apiculate.

Type collected by Elihu Hall in woods, at Houston, Texas, April 16, 1872, no. 830. Mr. G. C. Nealley also secured it in the same state in 1886.

Panicum psammophilum

A tufted perennial. Culms 2–4 dm. tall, appressed-hirsute below, puberulent above, finally much branched: leaves on the main culm about 4, occasionally 3 or 5; sheaths shorter than the internodes, appressed-pubescent, the basal ones with long hairs, the upper and those on the branches with very short hairs; ligule a dense ring of hairs about 1 mm. long; blades erect or nearly so, thick, firm, serrulate on the margins, puberulent beneath, the ovate-lanceolate basal ones, and occasionally also those on the culm, with a few very long scattered erect hairs on the upper surface, the primary blades lanceolate, 2–5 cm. long, 2–5 mm. wide, those on the branches 2–3 cm. long, 2–3 mm. wide; primary panicle broadly ovate, usually 2–3 cm. long, rarely larger, its axis and usually ascending branches puberulent: spikelets broadly obovate, 1.3–1.5 mm. long, rarely a little larger, and 0.8–1 mm. wide, obtuse, the outer 3 scales densely pubescent with spreading hairs, the first scale usually about one third as long as the spikelet, sometimes a little larger, 1-nerved, orbicular or broadly ovate, acute or obtuse, the second and third scales 9-nerved, the second usually a little shorter than the third, the fourth scale yellowish, 1.2–1.5 mm. long, oval.

In sandy soil, on or near the coast, Massachusetts to New Jersey. Specimens examined:

MASSACHUSETTS: Martha's Vineyard, *Miss Witman*, July, 1890; Ipswich, *Geo. V. Nash*, Aug. 25, 1898, no. *32*.

NEW YORK: Fisher's Island, *C. B. Graves*, Aug. 29, 1898, no. *12*.

NEW JERSEY: Wildwood, May 30 and 31, 1897, *E. P. Bicknell;* Tom's River, July 25–31, 1898, *W. N. Clute*, no. 175 (type); Tuckerton to Atsion, July 3–6, 1899, *W. N. Clute*.

Related to *P. Addisonii*, but at once distinguished by its smaller and relatively broader spikelets.

Panicum pseudopubescens

A densely tufted pubescent perennial. Culms usually rather stout at the base, 2–4 dm. tall, hirsute with ascending hairs, finally branched, the nodes barbed: leaves usually 3; sheaths less than one half as long as the internodes, densely hirsute with spreading hairs 1.5–2 mm. long; ligule a dense ring of hairs about 0.5 mm. long; blades erect, rather firm, lanceolate, serrulate and very rough on the margins, 4–10 cm. long, 3–11 mm. wide, densely hispid on the lower surface with spreading hairs, the upper surface with a ring of long stout erect hairs just back of the ligule and usually also more or less hirsute with spreading hairs: panicle considerably exserted, broadly ovate, 5–9 cm. long, its axis glabrous or with a few scattered hairs below, the branches with the axils sparingly hirsute, ascending or spreading, the larger ones 2.5–5 cm. long: spikelets 2.25–2.5 mm. long and 1–1.2 mm. wide, obovate, a little pointed, the first scale usually about one third as long as the spikelet, 1-nerved, glabrous or sparingly pubescent, broadly ovate or nearly orbicular, acute or obtuse, the second and third scales densely pubescent with spreading hairs about 0.25 mm. long, commonly 9-nerved, the second a little shorter than the third, the fourth scale nearly white, a little less than 2 mm. long and about 1 mm. wide, oval.

Type collected at Auburn, Lee Co., Alabama, May 7, 1898, by Messrs. F. S. Earle and C. F. Baker, no. 1537. Nos. 1522, 1524, 1526 and 1529, of this same collection, are also referred here. It is distinguished from any form of *P. pubescens* by its much larger spikelets, and from *P. Atlanticum* by the shorter pubescence and stouter culms

Panicum pubifolium

P. latifolium var. *molle* Vasey, Contr. U. S. Nat. Herb. **3**: 33. 1892. Not *P. molle* Sw. 1788.

P. Porterianum Nash, Bull. Torr. Bot. Club, **22**: 420. In part. 1895.

A softly pubescent densely tufted perennial. Culms 3–7 dm. tall, pubescent with soft weak spreading hairs, those at the base the longer, finally branched, the nodes densely barbed with long hairs: leaves 3–5; sheaths shorter than the internodes, often only one half as long, ciliate on the margins, densely pubescent, at least all but the uppermost, with spreading weak usually long hairs, also a dense ring of short hairs at the apex; blades spreading or ascending, minutely serrulate and very rough on the margins, ovate-lanceolate to ovate, acuminate, gradually narrowed to the rounded cordate-clasping base, often inequilateral, pubescent on both surfaces with short soft spreading hairs, the upper primary blades 7–11 cm. long and 2–3 cm. broad, the lower primary blades, as well as those on the branches, smaller: primary panicle usually but little exserted, sometimes included at the base, 7–11 cm. long, its axis, as well as the branches, densely pubescent with short soft spreading hairs, the branches spreading or ascending, the larger ones 3–4 cm. long, the secondary panicles much smaller, included at the base: spikelets 4–5 mm. long and about 1.6 mm. broad, narrowly obovate, the scales distantly inserted on the rachilla, the outer 3 scales strongly pubescent with long spreading hairs, the first scale 3-nerved, from two fifths to one half as long as the spikelet, obtuse or acute, the second scale 11-nerved, the third scale 9-nerved, the former a little shorter than the latter, the fourth scale yellowish, 3.5 mm. long and 1.4–1.6 mm. broad, pubescent at the obtusely apiculate apex.

Usually in rocky woods, New York to Missouri, south to Florida and Mississippi.

Among a large number of specimens of this grass examined, the following are referred to as well representing this species:

PENNSYLVANIA: Chestnut Hill, Easton, July 1, 1887, *T. C. Porter* (distributed as *P. Walteri molle*).

DISTRICT OF COLUMBIA: Washington, June 9, 1894, *Th. Holm*, no. 14 (distributed as *P. latifolium*).

VIRGINIA: Between Fall Creek and Danville, June 3, 1891, *J. K. Small* and *A. A. Heller*, no. 466 (distributed as *P. latifolium*).

MISSOURI: McDonald Co., July 24, 1893, *B. F. Bush*, no. 415 (distributed as *P. latifolium*); Montier, June 30, 1894, *B. F. Bush*, no. 754 (distributed as *P. Walteri*).

TENNESSEE: Knox Co., July 9, 1893, *T. H. Kearney, Jr.* (distributed as *P. Walteri molle*); Knoxville, July, 1898, *A. Ruth*, no. 78 (distributed as *P. Porterianum*).

GEORGIA: Stone Mt., Aug. 1–6, 1895, *J. K. Small* (distributed as *P. Porterianum*).

Readily distinguished from *P. Porterianum* by the pubescent sheaths and the lower surface of the blades and the hirsute panicle.

Panicum pyriforme

A densely tufted perennial. Culms 3–4 dm. tall, rather slender, glabrous, rather weak, finally much branched; leaves usually 2, or sometimes 3; sheaths much shorter than the internodes, densely papillose-hirsute with reflexed hairs; ligule a ring of hairs about 0.3 mm. long; blades thin, lax, glabrous on both surfaces, serrulate and very rough on the glabrous margins, long-acuminate, narrowed to the barely rounded base, 1–2 dm. long, 8–12 mm. wide, the basal ones often 2.5 dm. in length, the blades on the branches much shorter: panicle much exserted, ample, loose and open, 6–11 cm. long, its branches widely spreading, the larger ones 4–6 cm. long: spikelets rather few, about 2.5 mm. long and 1.5 mm. wide, broadly obovate, the first scale about one third as long as the spikelet, broadly triangular-ovate, 1-nerved, the second and third scales densely pubescent with long hairs, 9-nerved, the fourth scale yellowish white, about 2 mm. long and 1.5 mm. wide, oval, strongly apiculate.

Type collected by the writer in clay soil, at Orange Bend, Lake Co., Florida, March 12 31, 1894, no. 239. The larger spikelets and glabrous blades at once distinguish this from *P. laxiflorum*, to which it is otherwise related. The following numbers of my collection of 1895 are also referred here: 2034, 2156, 2531a.

Panicum strictifolium

A tufted perennial. Culms 2.5–5 dm. tall, strongly pubescent toward the base with long stiff hairs, puberulent toward the summit, finally much branched: leaves 3 or 4; sheaths much shorter than the internodes, the lower ones densely pubescent with long stiff appressed hairs, the upper ones more sparingly so; ligule a dense ring of hairs about 1 mm. long; blades erect or nearly so, rather firm, narrowly lanceolate, appressed-pubescent beneath with stiff hairs, the upper surface often with a few scattered long hairs, the lower blades also with a ring of very long stiff hairs just back of the ligule, serrulate and rough on the margins, the primary blades 4–7 cm. long, 3–5 mm. wide: panicle broadly ovate, 5–7 cm. long, its axis and spreading branches minutely pubescent, the lower branches 2.5–3.5 cm. long: spikelets obovate, 3 mm. long and about 1.5 mm. wide, the first scale a little more than one half as long as the spikelet, broadly ovate, clasping at the base, 3-nerved, sparingly pubescent, the second and third scales densely pubescent with rather long spreading hairs, 11-nerved, the second distinctly shorter than the third and the fourth, the fourth scale yellowish-white, oval, 2.5 mm. long and about 1.3 mm. wide.

Collected by the writer in the high pine land at Eustis, Lake Co., Florida, May 3, 1894, no. 603. Most nearly related to *P. malacon*, but distinguished by the less copious pubescence which is much finer and softer, and by the glabrous upper surface of the blades. From *P. ciliiferum* it is at once separated by its narrower blades which are not ciliate on the margins.

Panicum trifolium

A much tufted perennial, glabrous, with the exceptions noted below. Culms slender, 2–4 dm. tall, finally a little branched: leaves usually 3, rarely 4, the uppermost one much above the middle of the culm and generally but a little below the panicle; sheaths less than one half as long as the internodes, sometimes but one quarter as long: ligule a dense ring of hairs about 0.4 mm. long; blades erect or nearly so, firm, lanceolate, often minutely pubescent on the lower surface, the margins thickened and cartilaginous, serrulate and very rough, 1.5–6 cm. long, 1.5–5 mm. wide, the basal ones numerous, 4–6 cm. long: panicle more or less exserted, broadly ovate, 2.5–6 cm. long, its branches ascending, the larger ones 1.5–3 cm. long: spikelets 1.5 mm. long and about 0.7 mm. wide, elliptic, the first scale nearly orbicular, glabrous, 1-nerved, one quarter to one third as long as the spikelet, the second and third scales densely pubescent with short spreading hairs, 7-nerved, the fourth scale white, 1.3 mm. long and about 0.6 mm. wide, obtusely and obscurely apiculate.

In sandy soil, North Carolina to northern Florida, west to Mississippi. Type collected by Dr. John K. Small, in the Ocmulgee River Swamp, below Macon, Georgia, May 18–24, 1895. The following specimens are also referred here:

NORTH CAROLINA: Chapel Hill, *W. W. Ashe* (distributed as *P. ensifolium*).

SOUTH CAROLINA: Aiken, 1867, *H. W. Ravenel.*

FLORIDA: Chapman, 1890, no. 3; Apalachicola, 1892, *Dr. Geo. Vasey.*

ALABAMA: Buckley; Auburn, May 5, 1898, *Earle and Baker*, nos. 1534 and 1547a.

MISSISSIPPI: *S. M. Tracy*, Biloxi, Aug. 1, 1894, no. 2865, March 28, 1898, no. 4602, April 2, 1898, no. 4612; Avondale, April 28, 1898, no. 4610; Horn Island, June 1, 1898, no. 4613.

Related to *P. albomarginatum*, but distinguished by its thinner blades and more slender culms, which are leafy nearly to the panicle.

Delphinium Carolinianum and related Species

By P. A. Rydberg

None of our native larkspurs has been more misunderstood than *Delphinium Carolinanum* Walt., or *D. azureum* Michx. This species is found in the southern states only, its northwestern limit being in Missouri. All specimens from the western states referred to it belong to one of the other species described below. Any one who has collected specimens of so-called *D. azureum* in the prairie states or in the Southwest has found trouble in trying to harmonize the specimens collected with the descriptions in our manuals. Some years ago I came to the opinion that the *D. azureum* of Nebraska and neighboring states was quite different from the *D. azureum* of the South. It is only lately, however, that I have had occasion to give closer attention to the matter, in connection with a partial revision of the Ranunculaceae of Dr. Britton's Flora. I have come to the conclusion that *D. azureum*, as treated in Gray's Synoptical Flora, contains about ten species. I regret that I have not seen mature seeds of a few of the western species, as the seeds afford excellent characters for determination.

All the species treated here have a leafy stem and seeds with a loose cellular coat, that becomes transversely rugose squamellate. The most prominent characters by which they may be distinguished from each other are the following:

- Bractlets some distance below the calyx and below the thickened portion of the pedicel.
  - Sepals deep blue; principal segments of the leaves cuneate, cleft nearly or quite to the middle. 1. *D. geraniifolium.*
  - Sepals white, tinged with blue; segments cleft beyond the middle into narrow oblong or linear lobes.
    - Spur about twice as long as the petals; sepals obovate.
      - Spur straight or slightly curved.
        - Lobes of the lateral petals not diverging; lower pedicels not much elongated; spur mostly horizontal. 2. *D. albescens.*
        - Lobes of the lateral petals diverging; lower pedicels elongated; spur mostly erect. 3. *D. camporum.*
      - Spur strongly curved upward. 4. *D. Penardi.*
    - Spur thrice as long as the petals, slightly *s*-curved; sepals oblong. 5. *D. macroseratilis.*

Bractlets close under the calyx on the thickened end of the pedicels.
  Sepals greenish or yellowish white; segments of the upper leaves oblong. 6. *D. virescens.*
  Sepals blue or bluish; segments of the upper leaves narrowly linear.
    Plant tall, slender, green; bractlets narrowly linear, almost subulate.
      Seeds strongly wing-margined, only slightly rugose-squamellate; raceme simple and narrow. 7. *D. Carolinianum.*
      Seeds not wing-margined, strongly squamellate; raceme often branched. 8. *D. vimineum.*
    Plant low, stout, more or less canescent; bractlets linear or lanceolate.
      Sepals deep blue; pedicels ascending. 9. *D. Geyeri.*
      Sepals light blue or white, tinged with blue or purple; pedicels erect. 10. *D. Wootoni.*

1. **Delphinium geraniifolium** sp. nov.

Stem from a deep woody perennial root, stout, 3–4 dm. high, finely grayish-strigose; leaves numerous, especially at the base, long-petioled, grayish-strigose, mostly 5-divided to the base; divisions cuneate, twice 2–3-cleft into broad oblong divisions; racemes many-flowered, somewhat branched; pedicels ascending; bractlets linear, 2–4 mm. below the blue calyx; spur stout, horizontal, about one half longer than the petals, slightly curved; upper petals brownish, tipped with blue; seeds unknown.

This is evidently nearest related to *D. Geyeri*, but differs by the broad leaf segments and the form and position of the bractlets. Dr. Gray referred it to *D. vimineum*, which it resembles very little.

ARIZONA: Charles Valley, 1883, *H. H. Rusby.*

2. **Delphinium albescens** sp. nov.

Generally tall, 3–15 dm. high, from a woody branched root, finely pubescent or glabrate below, somewhat viscid above; leaves rather variable, from 5 to 15 cm. in diameter, repeatedly divided into linear or the lower often into oblong divisions; raceme long and simple, sometimes 5–6 dm. long; pedicels erect, 1–2 cm. long; bractlets narrowly linear, borne 2–4 (in fruit often 6–8) mm. below the calyx; sepals white with a blue spot and sometimes tinged with blue; spur stout, about twice as long as the petals, straight or slightly curved, tinged with blue, generally horizontal or ascending; upper petals very oblique at the summit, tinged with yellow; the lateral ones bearded, 2-cleft, but the lobes not diverging; follicles cylindric, pubescent; seeds 1.5–2 mm. long, brown, sharply angled but not wing-margined, rather strongly squamellate.

This species has been included in *D. Carolinianum*, but is easily distinguished by the color of the flowers, the form and position of the bractlets, the stouter habit, and especially by the seeds. Its distinctness from *D. camporum* is not so clear. The principal character used by Prof. Greene in order to distinguish the latter from *D. Carolinianum*, viz., the erect spur, does not hold, for *D. Carolinianum* sometimes has an erect spur; also *D. albescens*, as shown in Dr. Houghton's specimens from Lake Winnipeg. These were included by Greene in *D. camporum*, but are very unlike the plant from Texas, New Mexico and Arizona, which must be taken for the type of *D. camporum*. Houghton's plant differs in no respect, except the erect spur, from the common Larkspur of the Prairie Region. The specimens from Arkansas cited below are more slender and have narrower leaf-segments than is usual. The following specimens of *D. albescens* are found in the herbaria of the New York Botanical Garden and Columbia University.

MANITOBA: Lake Winnipeg, *Dr. Houghton.*

MINNESOTA: Hennepin Co., 1890, *J. H. Sandberg;* Fort Snelling, 1889, *E. A. Mearns.*

SOUTH DAKOTA: Scalp Creek (collector not given).

NEBRASKA: Lincoln, 1887, *H. J. Webber* (type); Crete, 1881, *G. D. Sweezey.*

KANSAS: Ft. Riley, 1892, *E. E. Gayle*, 484; Atchison, 1892, *E. B. Knerr;* Riley Co., 1895, *J. B. Norton, 8;* Topeka, 1891, *B. B. Smyth;* Manhattan, 1889, *W. A. Kellerman.*

COLORADO: Ft. Collins, 1896, *C. F. Baker.*

ARKANSAS: *Dr. Pitcher.*

INDIAN TERRITORY: Sapulpa, 1895, *B. F. Bush, 1091.*

TEXAS: San Antonio, 1894, *A. A. Heller, 1583.*

MISSOURI: Eagle Rock, 1898, *B. F. Bush, 228;* Independence, 1894, *7.*

ILLINOIS: Augusta, *S. B. Mead.*

3. DELPHINIUM CAMPORUM Greene, Erythea, **2**: 183

This species is closely related to the preceding, but is generally lower and stouter, with numerous basal leaves and few stem-leaves; the lower pedicels are much elongated, often 5 cm. long; the pedicels as a rule are strongly curved at the end, bringing the spur into an erect position. The flowers are similar to those of the preceding, but generally more purely white, and the lobes of the somewhat longer lateral petals are more divergent. The upper petals are less oblique at the top. To this species, I refer the following specimens :

NEW MEXICO : Jorunda del Murto, 1851, *Geo. Thurber, 291 ;* Mangus Spring, 1881, *H. H. Rusby, 5 ;* 1852, *C. Wright, 840.*

TEXAS : Rio Bravo del Norte, 1852, *Schott.*

4. DELPHINIUM PENARDI Huth, Helios, **10** : 27. 1892

I have seen no specimens of this species and from the description one would come to the conclusion that it is simply a form of *D. albescens,* the curved spur notwithstanding. We have seeds, however, received from M. E. Autran of the Boissier Herbarium, and these are very unlike those of *D. albescens.* They are large, black, very irregular, and only slightly squamellate ; in fact, they are almost identical with those of *D. Geyeri.* The upper petals are also described and figured as being toothed at the apex, a condition I have never seen in *D. albescens.*

5. **Delphinium macroseratilis** sp. nov.

Stem slender, about 3 dm. high, finely grayish-pubescent ; leaves divided to the base into 3–5 segments, these again 2–3-cleft ; raceme simple, strict, many-flowered ; pedicels erect, about 1 cm. long ; bractlets 2–4 mm. below the calyx, linear ; sepals white, the lower ones with a bluish spot, oblong, more than twice as long as the upper petals ; spur about three times as long as the upper petals, tinged with bluish, slightly s-curved ; upper petals very oblique and pointed at the summit ; lateral ones much longer, 2-cleft and bearded ; fruit and seeds unknown.

This is also closely related to *D. albescens,* differing in floral characters and the fewer segments of the leaves. Further study of the species is needed, especially as seeds are lacking.

TEXAS : Tom Greene Co., 1879, *Frank Tweedy.*

6. DELPHINIUM VIRESCENS Nutt. Gen. **2** : 14. 1818

There is only a fragmentary specimen in the Torrey Herbarium, but this is enough to show that it is quite distinct from *D. Carolinianum.* Not only is the corolla of a different color, but it is much larger and the spur is strongly hooked at the end. The plant is much stouter than *D. Carolinianum,* stouter even than any of the species given below. As the seeds are not known, the species may not belong to the group with squamellate seeds.

7. DELPHINIUM CAROLINIANUM Walt. Car. 155. 1788

D. azureum Michx. Fl. Bor. Am. **1** : 314. 1803.

D. Carolinianum is confined to the South, ranging from North Carolina, or perhaps Virginia, to Missouri and south to Florida, Lousiana and Arkansas. It is characterized by the slender habit, the small deep blue flowers, the long straight narrow raceme, the slender and slightly curved and usually horizontal spur.* The seeds are quite different from those of the related species, being smaller, only 1.5 mm. long, with broad wing-margins on the angles and only slightly squamellate on the sides. The following specimens are in the herbaria of the New York Botanical Garden and Columbia University.

GEORGIA: Augusta, 1888, *G. McCarthy*; Flint River at Albany, 1895, *John K. Small.*

FLORIDA: Jackson Co. (collector not given); *A. W. Chapman* (locality not given); West Florida, *Chapman.*

ALABAMA: *Buckley* (locality not given); Milstead, 1896, *L. M. Underwood;* Auburn, 1897, *Earle & Baker.*

MISSISSIPPI: Agency, 1897, *S. M. Tracy.*

MISSOURI: Swan, 1898, *B. F. Bush, 188.*

ARKANSAS: *Nuttall.*

8. DELPHINIUM VIMINEUM Don; Sweet, Brit. Fl. Gard. ser. 2, *pl. 374*

The flowers are similar to the preceding, but the plant is taller, often over a meter high, with slender lax branches. The most striking difference, however, is found in the seeds. These are scarcely angled at all, but with exceedingly strong transverse lamellae and over 2 mm. long. It is a species confined to the Gulf Region.

TEXAS: *Drummond.*

LOUISIANA: Alexandria, and Red River, *Hale.*

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* The specimens from Missouri cited here have almost erect spurs.

9. DELPHINIUM GEYERI Greene, Erythea, **2** : 189

This species is characterized by the strigose-canescent pubescence, the ascending instead of erect pedicels, the large blue flowers, the rather large bractlets, which often are half as long as the sepals and borne close under them. The species would not be placed in this group if it did not have squamellate seeds. These are, however, only finely so, rather large, about 3 mm. long, black, irregularly angled, but not wing-margined. The following specimens are in our herbaria :

WYOMING : Cheyenne, 1872, *E. L. Greene ;* Laramie River, 1894, *Aven Nelson, 400.*

COLORADO : Fort Collins, 1896, *C. F. Baker.*

10. **Delphinium Wootoni** sp. nov.

Perennial from a deep woody root, 1.5–2 dm. high, finely grayish-strigose ; basal leaves rather numerous, grayish-strigulose, rather firm, 3–5-cleft to the base, the divisions cuneate in outline, cleft beyond the middle into oblong or linear acute leaves ; stem-leaves similar, very few ; raceme short, rather few-flowered ; pedicels erect, 1–2 cm. long ; bractlets linear, close under the calyx, the latter light blue or white and tinged with blue or purple : petals white, the upper ones tinged with yellow ; seeds unknown.

This is closely related to *D. albescens*, but the position of the bractlets, the grayish pubescence, the low stout habit and the firm leaves with broad segments indicate some relationship with *D. Geyeri.* In this, as in several other species, mature seeds are a desideratum.

NEW MEXICO : Organ Mountains, 1893, *E. O. Wooton* (type).

ARIZONA : Ft. Huachuca, *T. E. Wilcox.*

New and interesting Plants from western North America.—VII

By A. A. Heller

Veratrum caudatum

Stems tall, 2–2.5 meters high, leafy, clothed with short woolly hairs : leaves glabrous, except the margins, which are slightly ciliate, those on the lower third of the stem elliptical or elliptical-lanceolate, 3–4 dm. long, 1.5–2 dm. wide ; those on the middle and upper portion of the stem lanceolate, gradually decreasing in size : inflorescence 4 dm. or more in length, branched below, the main rachis prolonged into a tail-like extension 2 dm. or more in length : floral bracts lanceolate, acuminate, about half the length of the perianth : perianth short-pedicelled, 1.5 cm. long, white, the green base pubescent, the divisions lanceolate or linear-lanceolate, only 2–3 mm. wide, slightly toothed, especially near the slender apex.

Our no. 4013, collected in wet meadows at Montesano, Chehalis county, Washington, July 6, 1898, at an elevation of about 50 feet. The type specimen is in my private herbarium.

This species is remarkable for the caudate upper portion of the inflorescence, no other species known to me approaching it in this respect. The divisions of the perianth are also unusually narrow. The plants are gregarious in habit, a dozen or two of them usually growing in proximity.

Verbena MacDougalii

Perennial, gray pubescent throughout : stems stout, simple, obtusely four-angled, the angles light colored, leafy throughout, 4 dm. high : leaves oblong-lanceolate, on short stout petioles, thickish, prominently veined, velvety to the touch, the margins scabrous, irregularly incised-serrate, 7–9 cm. long : spikes solitary or sometimes several, on pedicels 3 cm. long, dense while in flower, rather stout, the flowering portion 6 cm. long, but probably elongating in fruit : fruits scattered on the older lower portion of the spike : bracts slender, lanceolate, acuminately prolonged, 5 mm. long, one third longer than the calyx : flowers small, lilac-purple.

Dr. D. T. MacDougal's no. 249, collected July 8, 1898, " in moist soil in valley near Flagstaff, Arizona." The type specimen is deposited in the herbarium of the New York Botanical Garden.

The southwestern representative of *V. stricta.* It is less pubescent than that species, has a narrower leaf, the flowering spike is less compact in age, the flower is smaller and lighter colored, and the bracts are much longer. It also occurs near Santa Fé, New Mexico, growing in meadows along Santa Fé creek.

STACHYS PUBENS (A. Gray) Heller, Bull. Torr. Bot. Club, **25**: 582. 1898

Stachys ciliata var. *pubens* A. Gray Syn. Fl. N. A. **2**^{1}: 388. 1878.

Stachys palustris Linn. var. Torr., U. S. Explor. Exped. 17: 408.

This is a species quite distinct from *S. ciliata*, and apparently not well understood. The type was collected by Dr. Holmes on the Fraser river. Like most specimens from the older collectors, it is imperfect, showing only the upper half or third of what was evidently a tall, stout plant. The prominent angles are covered with retrorse, prickle-like hairs, the leaves are thick, densely pubescent with soft-pilose hairs, and have short stout petioles. The calyx is very hirsute, its lobes ending in a long spine-like tip. The flowers are more slender, and a trifle smaller than those of *S. ciliata.*

In the herbarium of Columbia University is a second sheet, also referred by Torrey to "*Stachys palustris* Linn. var." The label bears the legend "Gray's Harbor & S. to California." On the sheet are two plants, one of which is undoubtedly *S. ciliata*, and I take it to be the plant collected at "Gray's Harbor," for *S. ciliata* is abundant thereabouts. The other one probably goes with the "& S. to California." It is close to *S. pubens*, and may be the plant Gray had in mind when he mentioned *S. Rideri* in connection with his *S. ciliata* var. *pubens.*

STACHYS CILIATA Dougl.; Benth. Lab. Gen. et Sp. 539. 1834

Our no. 3960, collected at Montesano, Chehalis county, Washington, June 27, 1898, should be referred to this species, and not to *S. pubens*, under which name it was distributed. These specimens seem to be pretty typical, although a little more pubescent than typical material in the herbarium of Columbia University. This

Columbia specimen was presumably collected by Douglas, as it was received from Hooker, and is labelled "*Stachys ciliata*—Fl. Bor. Am." The Scouler specimen, no. 196, represented in the Columbia herbarium, is unlike any other specimen that I have seen, but it was taken from a deformed plant, which may account for the smaller and smoother calyx. Scouler's specimens are also cited as part of the type.

STACHYS EMERSONI Piper, Erythea, **6**: 31. 1898

Our 3902, collected at Montesano, Chehalis county, Washington, during June, 1898, and distributed as *S. ciliata*, is the recently described *S. Emersoni*. When the determination was made I had not seen any specimens of Piper's species, and was misled by the imperfect specimen of Scouler, mentioned above. *S. Emersoni* is apparently common in that part of Washington adjacent to Gray's Harbor, growing equally well in rich, shaded ground along streams, and in higher and drier places. A favorite place of growth about Montesano, was along fences and even in gardens and yards.

Stachys Cooleyae

Height of plant unknown, but probably several decimeters: stem sparingly retrorsely barbed below the inflorescence, the part occupied by the inflorescence puberulent or glandular-hairy: leaves distant, ovate-lanceolate, or the uppermost lanceolate, thin, light green, crenate-serrate, shortly acuminate, clothed on both sides with short appressed hairs which are not especially noticeable to the naked eye, those below the inflorescence 12–15 cm. long, 4–6 cm. wide, with rounded or cordate base, and slender, scarcely margined petioles 1–2 cm. long; floral leaves lanceolate, merely serrate, sessile, much reduced, but never shorter than the calyx: verticils remote, showing but slight tendency to approximation at the summit, normally six-flowered: calyx purplish, about 1 cm. long, moderately pubescent with spreading white hairs, the spreading lobes slightly over 2 mm. in length, lanceolate, tipped with a slender cusp: corolla pubescent, rose-purple, 2.5 cm. long, its tube twice the length of the calyx, lower lip broad and rounded, not longer than the upper one.

The type, preserved in the herbarium of Columbia University, was collected by Grace E. Cooley, at Nanimo, Vancouver Island, British Columbia, July 18, 1891. It was distributed as *Stachys ciliata* var. *pubens*, but differs from *S. pubens* by being less pubescent, has much thinner, larger leaves, on longer and more slender petioles; the inflorescence is less compact, the calyx is broader with broader and shorter spreading lobes, and the flower has a much broader tube and equal lips. It is closer to *S. ciliata*, but is distinguished by the thin, light green foliage, spreading calyx, and shorter, equally lobed corolla.

Pentstemon Arizonicus

Slender, erect, 1.5–2 dm. high, with several usually prostrate, short branches at base, these leaf-bearing only: leaves opposite, coriaceous, glabrous, dull green, those of the short prostrate branches oval, obtuse, finely crenate or merely undulate, 1–3 cm. long, 5 mm. to 1 cm. wide, tapering into a winged petiole; leaves of the erect stem in about five pairs, the lowest oblanceolate, petioled, finely crenate, about 2 cm. long, 5–7 mm. wide; those on the middle portion of the stem ovate-lanceolate, sessile at the broad base, thence gradually narrowing to the acute apex, a little over 3 cm. long, nearly 1 cm. wide at the base, entire, as are the upper shorter ones, which are lanceolate, acuminate: inflorescence appearing as if secund, lax, scattered over the upper half of the stem: peduncles and pedicels very slender, the former 1 cm. or more in length, nearly smooth, the latter about 5 mm. long, pubescent with slightly kinky hairs: calyx almost 1 cm. long, as long as the corolla-tube, pubescent and somewhat glandular, the lobes lanceolate, long-acuminate, slightly scarious near the base, ciliate: corolla apparently purplish, nearly 3 cm. long, minutely puberulent, abruptly dilated above the calyx: sterile filament glabrous, not enlarged above; anther sacs divergent.

Collected by Dr. D. T. MacDougal in shaded places on the inner slopes of the crater of San Francisco Mountain, near Flagstaff, Arizona, August 8, 1898. The type specimen is deposited in the herbarium of the New York Botanical Garden.

Erigeron MacDougalii

Appressed pubescent, perennial by decumbent rooting stems or stolons: stems slender, weak, curved, seldom or never branching; leaves entire, the basal ones spatulate, obtuse, 2 cm. long, more than half of which length is petiole; stem leaves scattered, linear or the lower ones linear-spatulate, acute or acutish, about 5 mm. long, 1 mm. wide: peduncles scapose, or very rarely borne on a branch, pubescent above, 5 cm. long; heads 1.5 cm. broad, 5 mm. high; involucre hemispheric, its bracts narrow, pubescent, somewhat scarious-margined, tipped with a brown point: rays numerous, purplish: pappus double.

Dr. D. T. MacDougal's no. 390, collected on "dry inner slopes of crater of San Francisco mountain," near Flagstaff, Arizona. The type specimen is deposited in the herbarium of the New York Botanical Garden.

A species related to *E. flagellaris*, but differing in its weaker, more prostrate, simple, downcurved stems, scape-like peduncles, minute leaves, and more pubescent involucre. It is very unlike typical *E. flagellaris* in habit.

Senecio MacDougalii

Perennial, stems rather slender, 4 dm. high, corymbosely branched from near the base, glabrous, leafy throughout: leaves 2-pinnatifid, 2–4 cm. long, the lower slightly petioled, the others sessile, the segments oblong, acute, 1 cm. long, 1–2 mm. wide, the lower ones lobed, the upper ones usually entire; rachis broad for the size of the leaf: heads numerous in corymbs, slender-peduncled, about 3 mm. broad and 7 mm. high: involucre 5 mm. high, the lobes linear-lanceolate, strongly costate, somewhat spreading, tipped with a brown ciliate point; rasys bright yellow, about 2 mm. broad: achenes glabrous: pappu white.

Dr. D. T. MacDougal's no. 342, collected near Flagstaff, Arizona, July 25, 1898. The type specimen is deposited in the herbarium of the New York Botanical Garden.

This species is related to *S. eremophilus*, but is smaller in every way. One difference which strikes the eye at once is the smaller, narrower heads. The leaves are also shorter. It was found "growing in clumps in remains of decayed pine trunks." Professor E. O. Wooton has collected specimens of this species in southeastern New Mexico.

THE GENUS PETALOSTEMON

In April, 1896, the writer published a paper in the BULLETIN entitled "Notes on *Kuhnistera*." In its inception, the idea was to keep separate under the generic name *Kuhnistera*, the Atlantic seaboard and Gulf coast plant long known as *Petalostemon corymbosus*, it being the type of *Kuhnistera*. Finally, though somewhat unwillingly, he was led to adopt the single genus theory, and included all of the species under *Kuhnistera*. Although there are several species of *Petalostemon* which have rather long calyx-lobes or broad floral bracts, they are so utterly unlike the peculiar plant of the southeastern part of the United States, which at first sight is often mistaken for a composite, that the two genera should not be united. Having described several species as *Kuhnistera* I now desire to transfer them to *Petalostemon,* where they properly belong.

Petalostemon Gattingeri

Kuhnistera Gattingeri Heller, Bull. Torr. Bot. Club, **23**; 121. 1896.

Petalostemon pulcherrimum

Kuhnistera pulcherrima Heller, Cont. Herb. F. & M. Coll. **1**: 50, *pl. 2.* 1895.

Petalostemon tenue (Coult.)

Petalostemon violaceus var. *tenuis* Coult. Cont. U. S. Nat. Herb. **1**: 34. 1890.

Kuhnistera tenuis Heller, Bull. Torr. Bot. Club, **23**: 124. 1896.

Petalostemon microphyllum (T. & G.)

Petalostemon phleoides var. *microphyllum* T. & G. Fl. N. A. **1**: 310. 1838.

Kuhnistera microphylla Heller, Bull. Torr. Bot. Club, **23**: 122. 1896.

BEDFORD PARK, NEW YORK CITY.

A new Genus of Powdery Mildews—Erysiphopsis

By Byron D. Halsted.

While at a meeting of the A. A. A. S., held in Madison, Wis., in August, 1893, and upon one of the delightful botanical excursions of the week the writer, in company with Prof. S. M. Tracy, found a mildew upon a *Parnassia* in considerable abundance. It has characteristics that do not admit it to any of the existing genera and as it approaches the *Erysiphe* more than any other, the next nearest being *Phyllactinia* the name of *Erysiphopsis*, that is, *like* or *similar* to *Erysiphe* is offered.

Erysiphopsis gen. nov.

Appendages rigid, brittle, usually nearly straight and frequently slightly swollen at the tip.

Erysiphopsis Parnassiae

Amphigenous, but most abundant upon the upper surface; hyphae inconspicuous. Perithecia widely scattered, almost black, 60–110 μ in diameter with reticulations coarse and distinct: appendages 8–15, about 10 μ in diameter at base and varying greatly in length—the shorter, 25–50 μ, being straight and brown throughout with the tips rounded and often distinctly swollen—while the longer are 2–5-septate, somewhat bent, the upper cell being pale brown and without distinctly swollen tips: asci 4–5, oval, pedicillate, 25–30 by 40–45 μ; sporidia oval, usually 4 (4–5), 6–8 by 12–16 μ.

On leaves of *Parnassia Caroliniana* Michx., Madison, Wis.

The key of the genera given below modified from that arranged by Dr. Burrill in his "Erysipheae"* will help to show the position taken by the new genus.

I. Appendages consisting of simple threads similar to the mycelium and often interwoven with it.
  1. Perithecia containing only one ascus. *Sphaerotheca.*
  2. Perithecia containing several asci. *Erysiphe.*
II. Appendages dissimilar to and free from the mycelium.
  A. Appendages simple—not usually forked at the tip.
    3. Appendages coiled at the tip. *Uncinula.*

---

* Parasitic Fungi of Illinois, Bull. Nat. Hist., 1887.

4. Appendages needle-shaped, abruptly swollen at base. *Phyllactinia.*
5. Appendages not coiled or needle-shaped. *Erysiphopsis.*

B. Appendages dichotomously forked at the tip.

6. Perithecia containing only one ascus. *Podosphaera.*
7. Perithecia containing several asci. *Microsphaera.*

It is not in the same group with *Erysiphe* and is closely associated with *Uncinula* and *Phyllactinia.*

The Saxifragraceae, to which the *Parnassia* belongs, do not abound in mildews and in the United States, they furnish a host for only one species of *Erysiphe* and two for a *Phyllactinia*. Thus *Heuchera Americana* L., is a host for *Erysiphe communis* (Wallr.) and *Heuchera parvifolia* Nutt., and *Philadelphus Lewisii* Pursh, are recorded as bearing *Phyllactinia suffulta* (Reb.). From the standpoint of hosts it is therefore seen that the new species is associted with the *Erysiphe* and *Phyllactinia.*

I am under many obligations to Professor Burrill for his kindness in examining the *Parnassia* mildew, and the suggestions that he has made upon its peculiarities and affinities.

The same fungus has been collected by several others. Dr. Harper, of Madison, Wis., in his reply to my query concerning the identity of the host, stated that he found the mildew at Waukegan, Ill., during the same year it was taken at Madison. Mr. F. L. Stevens, a former student of mine and now of the University of Chicago, found the same in considerable quantity near Syracuse, N. Y., and elsewhere. The species is probably not rare; but one not easily seen, because of the evanescent mycelium and the peculiar glabrous *Parnassia* leaves, as well as the inobtrusive habit of the host.

The Habitats of the Pellaeas

By E. J. Hill

While botanizing the present season along the Desplaines river and some of its tributaries between Lemont and Joliet, Ill., the habits of the cliff-brakes became a subject of special interest. *Pellaea atropurpurea* occurs quite abundantly on ledges of limestone bordering the flood plain of the river as well as on those by some of the smaller streams which have eroded their beds deep into the strata as they approach the gorge of the river. Numerous quarries are worked all along the river. The layers of rock are quite horizontal, and above the level of the flood-plain run back into the low hills and are heavily covered with drift. This has been removed in places to some distance back for the purpose of uncovering the stone, but as the ground rises the superincumbent earth becomes too deep to be taken off with profit, and the quarry is abandoned. Cliff-like, vertical walls are thereby left similar to those which have been made by natural agencies. The wall face thus exposed may have even a greater vertical height than those naturally formed. Some have evidently been left untouched by the quarrymen for many years. But no *Pellaea* was seen on any of these artificially made exposures, though various mosses and other forms of vegetation were well established. The fern, wherever found, grew upon rocks weathered to a dark gray, and with an exposure doubtless of many centuries' duration, or dating back to the time when a glacier carved out the rock bed of the river, its face only changing by the slow process of disintegration. In one locality the evidence was particularly strong. An island of rock had been left in the midst of the valley by the passage of the glacier around on either side, and on the old gray rock at the top of the ridge the fern was growing in plenty, but had not wandered down to a subsequently exposed rock-face made by quarrying below. This is not because the rock recently uncovered does not furnish cavities or shelves on which plants can readily grow, for the layers are relatively thin usually, from the thickness of flagstones to dimension stone two or three feet in depth, and crevices occur plentifully along the planes of joining. Besides the cliff-brake requires only a slight depression on which to grow. Tiny bunches of young plants, and fronds fruiting when less than an inch high, may be detected on the rocks. The plants wedge their roots into crevices so narrow that it is often difficult to get the bunch out intact. It is not easy to account for this preference of the fern for the old weathered surface. There is noticeable, however, a marked difference in the color of the recently exposed stone and that long subjected to weathering. Some chemical change is produced by atmospheric agencies, for the freshly exposed surfaces are soon stained with yellow or drab due to the presence of iron-oxide. This color is not seen on surfaces long exposed. The absence of the *Pellaea* may not be due to the presence of certain metallic ingredients in excess, but they suggest a possible or partial cause of it. I am able to state in addition that similar conditions have also existed in other localities where I have collected this fern, as witnessed by data on the herbarium labels. These were limestone cliffs in Kankakee county, Ill., they being formed in the same Niagara limestone as that along the Desplaines, the lower magnesian limestones along Root River, Preston, Minn., and the sandstone cliffs by Lake Mendota, Madison, Wis. I have seen the fern in other places, but no memoranda of its habitat being made at the time, I cannot speak with accuracy, but am impressed with the recollection that the exposures were very old. Most authorities that mention the kind of rock on which the cliff-break grows give limestone, but sandstone or other habitats are also mentioned.

Another feature in the behavoir of *Pellaea atropurpurea* is its aversion to shade. In the localities along the Desplaines it is mostly found in quite bright sunlight and on rock faces exposed in such a way as to be not only dry but very warm. Wherever the ledges were shaded but a little by trees the *Pellaea* ceased to grow. Some streams entering the river were examined. One had cut a deep gorge in the limestone below Lockport, and there were numerous exposures of the gray-weathered stone. But the fern was only seen in one place where a sharp bend in the stream, with the comparative absence of trees to shade it, gave the cliff a full exposure to the south. Another stream had made its way down to the river valley and formed a little waterfall where it emerged from the layers of rock. The projecting faces which flanked the basin below the fall were fully exposed to the sunlight and were well stocked with the plant. Above the fall was a little rocky glen, in dark shade, moist and covered with various kinds of moss and other shade-loving plants. Here the smaller cliff-brake, *Pellaea Stelleri*, found a congenial home, interspersed with *Cystopteris bulbifera*, *Marchantia polymorpha* and another Liverwort, *Asterella hemisphaerica*. It is a fern of quite different habit, showing its preference for rocks, but needing shade and moisture, as well as moss or decaying vegetable and rock-matter, in which its slender, horizontal rootstocks can run. It is the second locality in which I have met with this cliff-brake in Illinois, the other being a similar ravine or rock-cutting made by a brook entering the Kankakee river below the city of Kankakee. I have no information of its presence elsewhere in the state. Both stations are quite far south for it, and it must be here well-nigh the southern limits of its range.

CHICAGO, ILL.

Index to recent Literature relating to American Botany

Bartholomew, E. The Kansas Uredineae. Proc. Kansas Acad. Sci. **16**: 168–196. 1899.

List of 154 species with hosts, host index and copious notes on distribution.

Bicknell, E. P. Studies in *Sisyrinchium*—V. Two new eastern species.

Sisyrinchium arenicola and *S. intermedium*.

Biffen, R. H. A Fat-destroying Fungus. Ann. Bot. **13**: 363–376. *pl. 19*. S. 1899.

Bogue, E. E. Botanizing in Oklahoma. Asa Gray Bull. **7**: 91–93. O. 1899.

Boodle, L. A. On some Points in the Anatomy of the Ophioglosseae. Ann. Bot. **13**: 377–394. *pl. 20*. S. 1899.

Borge, O. Ueber tropische und sub-tropische Süsswasser-chlorophyceen. Bihang K. Sv. Vet.-Akad. Handl. **24**^{12}: 1–33. *pl. 1, 2*. 1899.

New species in *Oedogonium*, *Pleurotaenium*, *Xanthidium*, *Cosmarium*, *Euastrum*, and *Staurastrum* from South America and the West Indies.

Carleton, M. A. Cereal Rusts of the United States: A physiological Investigation. Bull. U. S. Dept. Agric. (Div. Veg. Path.) **16**: 1–73. *pl. 1–4*. 27 S. 1899.

Celakousky, L. J. Ueber achtzählige Cyklen pentamer veranlagter Blüthen. Jahrb. wiss. Bot. **33**: 368–416. *pl. 4*. 1899.

Chesnut, V. K. Preliminary Catalogue of Plants Poisonous to Stock. Ann. Rep. Bureau Animal Ind. for 1898: 387–420. *f. 38–69*. 1899.

Clements, F. E. Contributions to the Histogenesis of the Caryophyllales I. Trans. Am. Microscop. Soc. **20**: 97–160. *pl. 8–25*. 1899.

Discusses histology of species of *Dianthus*, *Silene*, *Portulaca*, *Allionia*, *Amarantus*, *Beta*, *Chenopodium* and *Phytolacca*.

Clute, W. N. *Dryopteris simulata* in New York State. Fern Bull. **7**: 91, 92. O. 1899.

Coulter, J. M. Plant Relations, a first Book of Botany. 12mo. i–x, 1–264. *f. 1–206*. New York. 1899.

Cook, O. F. Four Categories of Species. Am. Nat. **33**: 287–297. Ap. 1899.

Cook, O. F. On biological Text-books and Teachers. Science, II. **9**: 541–545. 14 Ap. 1899.

Cook, O. F. Stability in generic Nomenclature. Science, II. **8**: 186–190. 12 Au. 1898.

Cook, O. F. The Method of Types. Science, II. **8**: 513–516. 14 O. 1898.

Davenport, G. E. *Lycopodium alopecuroides.* Fern Bull. 7: 97. O. 1899.

Eaton, A. A. The genus *Equisetum* with reference to the North American Species. Fourth Paper. Fern Bull. 7: 85–88. O. 1899.

Ferriss, J. H. The Tennessee Locality for the Hart's-tongue Fern Fern Bull. 7: 98, 99. O. 1899.

Fritsch, K. Ueber einige während der ersten Regnell'schen Expeditiongesamelte Gamopetalen. Bihang K. Sv. Vet. Akad. Handl. **24^5**: 1–28. *pl.* 1898.

New species in *Scoparia, Drymonia* and *Ruellia.*

G[rout], A. J. Key to the *Mniums* of Northeastern North America. Fern Bull. 7: 105–107. O. 1899.

Groom, P. On the Fusion of Nuclei among Plants: A Hypothesis. Trans. Bot. Soc. Edinb. **21**: 132–144. 1899.

Ganong, W. F. The Teaching Botanist. 12mo. i–xi, 1–270. *f. 1–29.* New York, 1899.

Hill, R. T. Notes on the Forest Conditions of Porto Rico. Bull. U. S. Depart. Agric. (Div. Forestry), **25**: 1–48. *pl. 1–8.* 1899.

Harshberger, J. W. Thermotropic movement of the Leaves of *Rhododendron maximum* L. Proc. Acad. Nat. Sci. Phila. 1899: 219–224. 1899.

Holzinger, J. M. Some additional Notes on the Methods of microscopic Examination of Mosses. Fern Bull. 7: 107–109. O. 1899.

Holm, T. Studies in the Cyperaceae.—X., XI. Am. Jour. Sci.—**7**: 435–450. *f. 1–14.* Je. 1899; **8**: 105–110. *f. 1–7.* Au. 1899.

Anatomy of *Fimbristylis* and abnormal development of *Carex stipata.*

Hitchcock, A. S. List of Plants in my Florida Herbarium. Trans. Kansas Acad. Sci. **16**: 108–157. 1899.

List of 1,256 species.

Jaderholm, E. Anatomiska Studier öfver Sydamerikanska Peperomier. 8vo. 1–97. *pl. 1, 2.* Upsala. 1898.

Kellerman, W. A. Distribution of the Rue Spleenwort in Ohio. Fern Bull. **7**: 96. O. 1899.

Knowlton, F. H. Fossil Flora of the Yellowstone National Park. Monog. U. S. Geol. Surv. **32**: 651–791. *pl. 77–121.* 1899.

Describes 82 new species.

Kuntze, O. The Advantages of 1737 as a Starting Point of Botanical Nomenclature. Bull. Torr. Bot. Club, **26**: 488–492. 22 S. 1899.

Luther, A. Ueber *Chlorosaccus*, eine neue Gattung der Süsswasseralgen, nebst einigen Bemerkungen zur Systematik verwandter Algen. Bihang K. Sv. Vet.-Akad. Handl. **24**^{13}: 1–22. *pl.* 1899.

Chlorosaccus fluidus n. gen. et sp.

Leisering, B. Ueber die Korkbildung bei den Chenopodiaceen. Ber. Deutsch. Bot. Ges. **17**: 243–255. *pl. 20.* 27 Au. 1899.

Lindman, C. A. M. Leguminosae Austro-Americanae ex itinere Regnelliano primo. Bihang K. Sv. Vet.-Akad. Handl. **24**^{7}: 1–60. *f. 1–13.* 1898.

New species in *Camptosema*, *Phaseolus*, *Machaerium*, *Conbiandia*, *Bauhinia*, *Mimosa* and *Pithecolobium*.

MacBride, T. H. The North American Slime Moulds. 8vo. i–xviii, 1–231. *pl. 1–18.* New York. 1899.

Macoun, J. M. Contributions to Canadian Botany. Part XIII. Ottawa Nat. **13**: 158–169. O. 1899.

Malme, G. O. Ex herbario Regnelliano. Adjumenta ad floram Phanerogamicam Brasiliae terrarumque adjacentium cognoscendam, II. Apocynaceae. Bihang K. Sv. Vet.-Akad. Handl. **24**^{10}: 1–37. *pl. 1–3.* 1899.

New species in *Apidosperma*, *Rauwolfia*, *Prestonia* and *Haemadictyon*.

Malme, G. O. Xyridaceae Brasilienses precipue Goyazenses a Glaziou lectae. Bihang K. Sv. Vet.-Akad. Handl. **24**^{3}: 1–20. *pl.* 1898.

Malme, G. O. Ex herbario Regnelliano. Adjumenta ad floram phanerogamicam Braziliae terrarumque adjacentum cognoscendam, I. Bihang K. Sv. Vet.-Akad. Handl. **24**^{6}: 1–30. 1898.

Maxon, W. R. Some Variations in the Adder's-tongue. Fern Bull. **7**: 90, 91. O. 1899.

Meehan, T. *Asclepias tuberosa.* Meehan's Month. **9**: 145, 146. *pl. 10.* O. 1899.

Meehan, T. *Bidens connata.* Meehan's Month. **9**: 97, 98. *pl. 7.* Jl. 1899.

Meehan, T. *Solidago stricta.* Meehan's Month. **9**: 113, 114. *pl. 8.* Au. 1899.

Mottier, D. M. The Effect of centrifugal Force upon the Cell. Ann. Bot. **13**: 325–362. *pl. 18.* S. 1899.

Miller, G. S., Jr. The Dogbanes of the District of Columbia. Proc. Biol. Soc. Washington, **13**: 79–90. *pl. 2.* 28 S. 1898.

A. speciosum, A. urceolifer and *A. nemorale*, new species.

Nelson, A. New Plants from Wyoming.—X. Bull. Torr. Bot. Club, **26**: 480–487. 22 S. 1899.

New species and varieties in *Potentilla, Castilleja, Oonopsis, Petradoria, Tetradymia, Senecio, Tanacetum, Artemisia, Malacothrix, Lactuca* and *Crepis.*

Norton, J. B. S. A Bibliography of Literature relating to the effects of Wind on Plants. Trans. Kansas Acad. Sci. **16**: 103–105. 1899.

Palmer, W. Ferns of the Dismal Swamp, Virginia. Proc. Biol. Soc. Washington, **13**: 61–70. *pl. 1.* 28 S. 1899.

Dryopteris Goldieana celsa var. nov.

Pilger, R. Gramineae Lehmannianae et Stubelianae Austro-Americanae additis quibusdam ab aliis collectoribus ibi collectis determinatae et descriptae. Engler. Bot. Jahrb. **27**: 17–36. 7 Ap. 1899.

Pinchot, G. A Primer of Forestry. Part I.—The Forest. Bull. U. S. Dept. Agric. (Div. Forestry), **24**: 1–88. *pl. 1–47. f. 1–83.* 1899.

Pollard, C. L. Notes on some South Florida Ferns. Fern Bull. **7**: 88–90. O. 1899.

Richards, H. M. The Effect of chemical Irritation on the economic Coefficient of Sugar. Bull. Torr. Bot. Club, **26**: 463–473. 22 S. 1899.

Robertson, R. A. On abnormal Conjugation in *Spirogyra.* Trans. Bot. Soc. Edinb. **21**: 185–191. *pl.* 1899.

Rothert, W. Ueber parenchymatische Trächeiden und Harz gänge in Mark von Cephalotaxus-arten. Ber. Deutsch. Bot. Ges. **17**: 275–290. *pl. 21.* 27 Au. 1899.

Rothrock, J. T. White Birch. American White Birch. Gray Birch (*Betula populifolia*). Forest Leaves, **7**: 72, 73. O. 1899. [Illus't.]

Sayre, L. E. Therapeutical Notes and Descriptions of Parts of Medicinal Plants growing in Kansas. Trans. Kansas Acad. Sci. **16**: 85–88. 1899.

Schwabach, E. Zur Kenntniss der Harzabscheidungen in Coniferennadeln. Ber. Deutsch. Bot. Ges. **17**: 291–302. *pl. 22.* 27 Au. 1899.

Shear, C. L. Some common autumnal Species of edible Fungi. Asa Gray Bull. **7**: 93–95. O. 1899.

Smyth, B. B. Floral Horologe for Kansas. Trans. Kansas Acad. Sci. **16**: 106–108. *pl. 9.* 1899.

Smyth, B. B. Additions to the Flora of Kansas. Trans. Kansas Acad. Sci. **16**: 158–167. 1899.

Includes 235 additions to the State Flora, including 45 fungi with new species in *Phyllosticta*, *Phoma*, *Dothiorella*, *Sphaeropsis*, *Hoplosporella* (4), *Diplodia*, *Hendersonia*, *Stagonospora*, *Camarosporium* and *Cladotrichum* by Ellis and Bartholomew.

Soave, M. Sulla funzione fisiologica dell acido cianidrico nelle piante. Esperienze sulla germinazione delle Mandorle amare e dolci. Nuovo Giorn. Bot. Ital. II. **6**: 219–238. Ap. 1899.

Spegazzini, C. Nova addenda ad Floram Patagonicam. Anales Soc. Cien. Arg. **48**: 44–59. Jl. 1899.

New species in *Oenothera*, *Pterocactus*, *Tetragoria*, *Azorella* and *Mulinum*.

Stansfield, F. W. On the Production of Apospory by Environment in *Athyrium filix-foemina* var. *unco-glomeratum*, an apparently barren Fern. Jour. Linn. Soc. **34**: 262–268. 1 Jl. 1899.

Sterling, E. B. Toadstools. 1–10. *pl.* Federalburg, Md. Au. 1899.

Stone, G. E. Flora of Lake Quinsigamond [Mass.]. 1 Jl. 1899.

Tracy, S. M., & Earle, F. S. New Fungi from Mississippi. Bull. Torr. Bot. Club, **26**: 493–495. 22 S. 1899.

New species in *Aecidium*, *Ustilago*, *Cerebella*, *Coniosporium* and *Cercospora*; *Diplodina quercuum* nom. nov. (= *Sphaerellopsis quercuum* Cke).

Trelease, W. Alvin Wentworth Chapman. Am. Nat. **33**: 643–646. Au. 1899. [Illust.]

True, R. H., & Hunkel, C. G. The poisonous Effects Exerted on Living Plants by Phenols. Bot. Centralb. **76**: 289–295, 321–327. No. 11.

Thom, C. The Process of Fertilization in *Aspidium* and *Adiantum*. Trans. Acad. Sci. St. Louis, **9**: 285–314. *pl. 36.* 4 Au. 1899.

Uline, E. B. Studies in the Herbarium, I. *Higinbothamia*, a new Genus and other new Dioscoreaceae. New Amaranthaceae. Field Columb. Mus. Bot. **1**: 413–422, *pl. 22–24.* Au. 1899.

New species in *Higinbothamia* nov. gen., *Dioscorea*, *Alternanthera* and *Iresine*.

Underwood, L. M. Moulds, Mildews and Mushrooms. A Guide to the systematic Study of the Fungi and Mycetozoa and their Literature. 12mo. i–vi, 1–236. *pl. 1–9, and colored frontispiece.* New York. S. 1899.

Underwood, L. M. *Asplenium ebenoides*—a Correction. Fern Bull. **7**: 95, 96. O. 1899.

Underwood, L. M. The Royal Botanic Gardens at Kew. Science, II. **10**: 65–75. 21 Jl. 1899.

Ule, E. Die Verbreitung der Torf-moose und Moore in Brasilien. Bot. Jahrb. Engler, **27**: 238–240. 7 Ap. 1899; 241–258. 15 S. 1899.

Vail, A. M. Studies in the Asclepiadaceae—IV. Bull. Torr. Bot. Club, **26**: 423–431. 17 Au. 1899.

Notes on type specimens in *Asclepias*, *Gonolobus* and *Mellichampia*. *Asclepias parvula* (A. Gray), *Stelmagonium Holtoni*, *Mellichampia ligulata* (Benth.), *Gonolobus volubilis* (Turcg.), *Vincetoxicum Floridanum*, *V. crenatum*, *V. Greggii*, *V. acuminatum* (A. Gray), and *V. productum* (Torr.), new species and names.

Vidal, L. Sur le placenta des Primulacées. Jour. de Bot. **13**: 139–146. My. 1899.

Vilmorin, H. L. de. Selection and its Effects on cultivated Plants. Exper. Station Record, **11**: 3–19. 1899.

Vries, H. de. On Biastrepsis in its Relation to Cultivation. Ann. Bot. **13**: 395–420. S. 1899.

Wagner, R. Eine neue *Carludovica*. Allg. Bot. Zeit. 1899: 137, 138. 15 S. 1899.

Carludovica Goebelii Weiss et Wagner, from Venezuela.

Wainio, A. Lichenes novi rarioresque. Hedwigia (Beiblatt), **38**: (121)–(125). 26 Je. 1899.

New species in *Usnea*, *Parmelia*, *Anzia*, *Cladonia* and *Coenogonium* from Bogota.

Waters, C. E. Fern Stems. Fern Bull. **7**: 92–94. O. 1899.

Weber-van Bosse, A. Note sur quelques algues rapportées par le yacht "Chazalic." Jour. de Bot. **13**: 133–135. My. 1899.

West, W. & G. S. A further Contribution to the Fresh-water Algae of the West Indies. Jour. Linn. Soc. **34**: 279–295. 1 Jl. 1899.

West, G. S. On Variation in the *Desmidieae* and its Bearings on their Classification. Jour. Linn. Soc. **34**: 366–416. *pl. 8–11.* 1 Jl. 1899.

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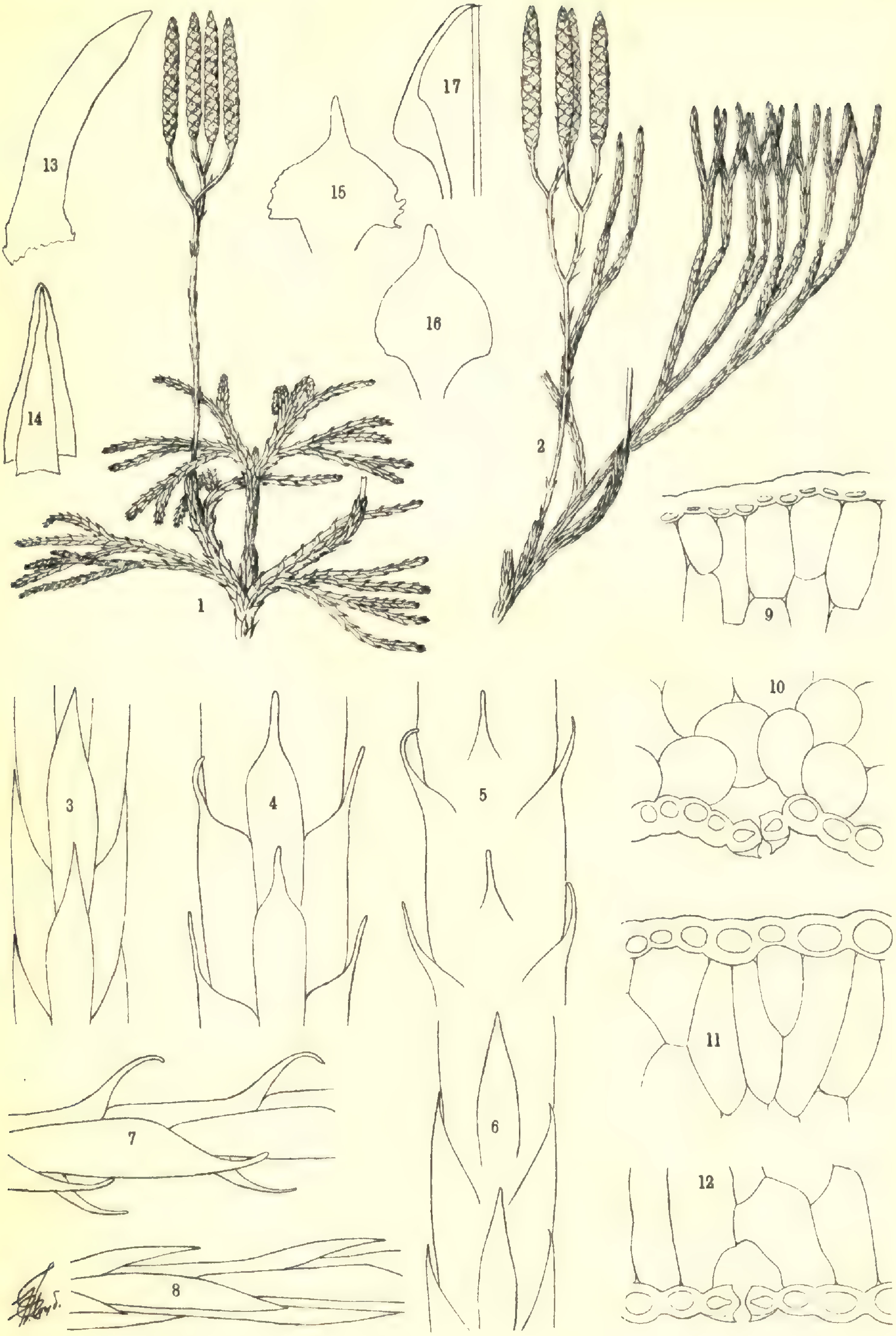
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VOL. 26 No. 12

BULLETIN

OF THE

TORREY BOTANICAL CLUB

DECEMBER 1899

Studies in Sisyrinchium—VI: Additional new Species from the Southern States

BY EUGENE P. BICKNELL

In the South Atlantic and Gulf States the genus *Sisyrinchium* has expressed itself with marked emphasis. Although not hitherto regarded as forming more than a very insignificant feature of the southern flora the group actually embraces such a number of species that it must take rank among the largest homogeneous genera of the south. These numerous species in their general near relation yet perfect distinctness call to mind especially the interesting brotherhood of species in *Eupanicum* among the grasses.

Since the publication of the first paper of this series describing some of these plants, additional material from the South has been received which reveals a further considerable number of species not hitherto suspected to exist. These come to light mainly through the important collection of the Biltmore Herbarium, kindly placed at my disposal by Mr. C. D. Beadle, and through an interesting series of specimens from the South Atlantic States forwarded by Mr. W. W. Ashe.

Including the new species here described the total number now known to me from the region south of Washington, D. C., and east of the Mississippi is thirty-four. I have no reason to doubt the perfect validity of any one of these, but, on the contrary, am well satisfied that certain of them, as *S. Carolinianum* and *S. Atlanticum*, are still aggregates and that the number of species from the Southern States will yet be materially augmented.

[Issued Dec. 22.]

The Texan species will be treated separately in a subsequent paper.

Sisyrinchium incrustatum

Dull green and slightly glaucescent, turning dark when dry, 25–50 cm. high: tufts coarsely brown fibrose at base, the slender roots much elongated. Leaves more than half the height of the stem, 1.5–3.5 mm. wide, erect, tapering to an aculeate point, rather thin but firm and chartaceous, usually harshly rugulose-scabrous between the nerves but varying from merely rugulose to densely incrustate with minute pale points, strongly close-nerved and striate, the striae below becoming prominent and pale in color, often with a lesser alternating series: stems often somewhat curved and twisted, 1.5–3 mm. wide, harsh and scabrous-rugulose like the leaves, especially the prominent wings, the edges like those of the leaves, closely ciliolate-serrulate; nodes one or two, the lower one bearing an erect and prominent often much elongated leaf and two or three peduncles, the upper one terminating an outcurved prolongation of the stem 4–9 cm. long and with a shorter bracteal leaf and mostly three shorter peduncles; peduncles often outcurved, stout or slender, winged, stiff-ciliolate, bracteal leaves harsh and striate like the lower leaves, the clasping base somewhat broadened and oppositely bicarinate: spathes erect or slightly bent, the subequal bracts 15–25 mm. long, stiff and strongly fine-striate, slenderly sharp attenuate to merely acute or the inner one apiculate from a scarious-margined apex, the outer one very narrowly hyaline-margined, smooth or obscurely scabrous-rugulose: scales silvery-brown, acuminate, more than three-quarters the length of the inner bract; flowers 4–9, violet-blue, perianth about 8 mm. long; stamineal column 4–5 mm. high; capsules dark, subglobose, 3–4 mm. high on suberect slightly exserted pedicels; seeds 1–1.25 mm. in diameter, subglobose, finely pitted.

NORTH CAROLINA: in damp or wet sandy soil or in open grassy woods, flowering in July, Forsythe Co., Winston, July, 1897, W. W. Ashe; Sampson Co., W. W. Ashe; Craven Co., July 3, G. McCarthy, U. S. Nat. Herb.

Related to *S. arenicola* and *S. xerophyllum* Greene and apparently in close affinity with *S. rufipes* although a much larger and stouter plant in every way and flowering in midsummer instead of early spring.

Sisyrinchium versicolor

Becoming 35 cm. high, pale green and very glaucous, not drying dark, the sheaths of the leaves rose-pink and the spathes mostly purplish-tinged; tufts not fibrous at base; roots slender and wiry. Leaves 1.5–3 mm. wide, close-striate, stiff, tapering to an acute point, the edges, like those of the stem mostly serrulate-roughened: stem simple or frequently developing a node with a prominent erect leaf and two peduncles, 1–2.5 mm. wide, the wings distinctly striate: spathes erect, the base narrowed downwards on the sides of the stem, the wings passing up on either side; bracts and lower part of bracteal leaf closely roughened all over with minute points, often prominently striate: outer bract much prolonged beyond the inner in simple stems, little surpassing it when the stem is branched, 2.5–5 cm. long, very acute, the narrowly hyaline margins not united below; inner bract narrow, 17–20 mm. long, often scarious and abruptly pointed at the apex: flowers pale blue, 10–12 mm. long; stamineal column about 5 mm. high: capsules on very delicate, slenderly exserted, subspreading pedicels, pale, apparently subglobose and about 3 mm. high, but not fully mature in the specimens examined.

Washington, D. C., to Georgia, flowering in May.

Washington, D. C., May 11, 1884, U. S. Nat. Herb.

NORTH CAROLINA: Raleigh, May, 1896, hillsides, W. W. Ashe, Type; Chapel Hill, W. W. Ashe.

GEORGIA: A. W. Chapman in Herb. Torr. Bot. Club.

Apparently nearest to *S. intermedium* and *S. mucronatum*, but as compared with both much paler and more glaucous with stiffer more striate leaves and stem and scabrellous bracts. The roughened bracts have much the appearance of those of the twin-spathed *S. scabrellum* or of extreme forms of the more western *S. campestre*. The latter is a lower more slender species, with always simple stems, the inner bract emerging from the outer one more abruptly and at a point much nearer the less narrowed base of the spathe.

Sisyrinchium Asheianum

Caespitose in close tufts, 20–30 cm. high, not fibrillose-coated at base, pale green and glaucescent, the leaf sheathes and spathes purplish to deep wine-purple; leaves half the height of the stem or longer, erect, 0.5–1.5 mm. wide, close-striate, smooth or sometimes roughened, tapering to a hardened acute or obtusely pointed tip: stems mostly about 1 mm. wide, the margins distinctly few-striate, the edges smooth or denticulate: spathes twin, or even three together, or in reduced stems sometimes solitary, sessile at the top of the stem and subtended by an erect bracteal leaf 2–6 cm.

long; bracts of spathes subequal, 10–16 mm. long, distinctly nerved, glabrous or slightly roughened with minute often purplish points, abruptly scarious obtuse and apiculate to attenuate; inner bract of outer spathe equaling or mostly exceeding the outer one; interior scales silvery white, from half to three quarters the length of the bracts; flowers on hair-like exserted pedicels usually subspreading from the top of the spathe; perianth deep violet-blue, 7–10 mm. long, stamineal column 4–5 mm. high: fruit not seen.

NORTH CAROLINA: Salisbury, Rowan Co., April 28, 1897, in wet meadows. Biltmore Herbarium.

Intermediate in appearance with *S. mucronatum* and *S. scabrellum* and related also to *S. albidum* and *S. capillare.* From *S. mucronatum* it is distinguishable at once by its geminate spathes without regard to other characters. *S. albidum* differs in brighter green color, broader, softer and less striate leaves and stem, larger spathes with the broader base passing more abruptly across the sides of the stem and with the bracts greener and more herbaceous and attenuate, less exserted pedicels, paler or white and larger flowers. *S. capillare* is altogether more slender and delicate, and differs further in fibrillose-coated base, merely margined stem, and smaller spathes having narrower more attenuate bracts broadly white hyaline on the margins.

S. Asheianum clearly bears a very close relationship to *S. scabrellum* but is mostly a much lower plant with narrower leaves and stem, less slender roots, more highly colored bracts which are much less herbaceous and attenuate, and smaller, deeper blue flowers; it is moreover either quite glabrous throughout or with only obscure indications of the scabrellous investiture of bracts and leaves which is so noteworthy a character of *S. scabrellum.* The latter, as recorded on collectors' labels, is a plant of dry woodlands, *S. Asheianum* of wet meadows.

Named for Mr. W. Willard Ashe, whose collection of southern *Sisyrinchia* has furnished several new species and who was himself about to publish as new the plant here described.

Sisyrinchium capillare

Extremely slender and delicate, growing in erect thin tufts 20–45 cm. high, closely erect-fibrillose at base; glaucescent, drying a dull olive-green, the spathes and leaf-bases often tinged with pale dull purple; roots slender and wiry. Leaves from half to three quarters the height of the stems, closely erect, almost filamentary, mostly .05 mm. or less wide and strongly 2–4-striate, very smooth, attenuate-acute, in age often developing hardened tips: stems equally slender with the leaves, wiry and subterete, not winged but narrowly firm-margined, the edges smooth: spathes mostly two or sometimes single, rarely three together, sessile at the top of the stem and closely subtended by an elongated primary bract, very small, 10–13 mm. long, the bracts subequal, mostly very acute or aculeate, somewhat membranous but distinctly nerved, glabrous, the margins conspicuously white-hyaline; primary bract straight and setaceously slender, usually much elongated, 2–8.5 cm. long, the edges narrowly white-hyaline towards the striate base which is on both sides rather abruptly broader than the stem; interior scales silvery-white, usually but little shorter than the bracts: flowers light violet-blue on slenderly exserted, loosely erect, or finally flexuously spreading pedicels; perianth 6–8 mm. long; stamineal column about 4 mm. high: capsules pale, subglobose, 2–3 mm. high; seeds irregularly obovoid-subglobose, black, distinctly alveolate, about .75 mm. in diameter.

NORTH CAROLINA to Florida, mostly in flat sandy woods, flowering in April and May.

NORTH CAROLINA: "Read," Herb. Acad. Nat. Sci. Phil.: Selma, April, 1899, W. W. Ashe.

SOUTH CAROLINA: Aiken, May, 1899, W. W. Ashe.

GEORGIA: Brunswick, April 16, 1899, W. W. Ashe.

FLORIDA: South of Jacksonville, fourteen and twenty miles, May 13 and 18, 1899, W. W. Ashe.

An exceedingly delicate plant, being one of the most slender species of the entire genus. In its most slender state, the stems and leaves appear almost thread-form, yet the plant may be equally tall with some of the stoutest species.

Sisyrinchium dichotomum

Dull yellowish-green and glaucescent, not turning dark when dry, 30–40 cm. high, in thin erect tufts, not fibrose-coated at base, the roots slender and simple or nearly so. Leaves rather few, mostly about half the height of the plant, or a few longer, somewhat openly erect, 2–6 mm. wide, often broadened upward to above the middle and tapering-acuminate, rather thin but firm, minutely crystalline-puncticulate, the broader ones somewhat distantly striate-nerved, the edges very minutely close-serrulate to nearly smooth: stems broadly thin-winged and similar to the leaves: inflorescence more or less dichotomous from 2–4 series of nodes, the primary node often below the middle of the plant; leaves of the lower nodes very prominent, elongated and acuminate, manifestly broadened about the middle, sometimes even wider than the basal leaves; branches slightly diverging, usually only one of each pair forked, at least above the first or second node, the lower nodes usually bearing also 2–3 slender, often curved peduncles sometimes over 10 cm. long; uppermost peduncles 3–5 cm. long, often very slender and curved; lower branches 6–12 cm. long, broadly winged, the upper series increasingly shorter and more slender: spathes green, very small, often scarcely broader than the peduncles and keeled on either side of the narrowed base by its ascending wings, straight, the bracts very narrow, thin and weakly few-nerved, sharp edged, more or less unequal; outer bract slenderly attenuate, mostly prolonged beyond the inner one for 2–7 mm., the edges very narrowly white-hyaline below, united-clasping for 2–3 mm. at base; inner bract 8–15 mm. long, slender-pointed; flowers 3–9, white in the only specimens seen, very small, perianth about 5 mm. long, stamineal-column 2–3 mm. high: capsules rather pale and thin-walled, trigonous-subglobose or obovoid, about 3 mm. high on very slender, flexuously-erect, exserted pedicels 15–23 mm. long; seeds only 1–2 in each cell, large, 1.5–2 mm. in diameter, somewhat flattened-subglobose or obovoid, often bluntly angled, strongly umbilicate, black, at first rugulose, but becoming smooth or nearly so and even somewhat shining.

NORTH CAROLINA: Chimney Rock, Rutherford Co., May 11, 1899, fruit mature and only a few flowers remaining. Biltmore Herb.

A rather remarkable species, especially noteworthy by reason of its successively dichotomous system of branching, ample stem-leaves, very small white flowers, small capsules and few large seeds. Apart from its much greater amount of branching its general aspect is perhaps most like that of *S. graminoides* or forms of *S. Carolinianum*, though it may be more nearly related to the following species. It has smaller flowers, broader stem-leaves and fewer larger seeds, than any other eastern species known to me.

Sisyrinchium tenellum

Growing in loose often leafy tufts 15–30 cm. high, not fibrose-coated at base, rather dark dull green, apparently not even glaucescent, usually turning dark in drying; roots soft and slender. Leaves often equaling the stems though sometimes only half as high, very thin and grass-like, soft and openly erect or sometimes firmer and strictly erect, 1–3 mm. or even 4 mm. wide, tapering and cuspidate, acute, distinctly few-nerved with fainter nerves in the very wide interspaces, the edges, as are those of the stem, very smooth or, sometimes, ciliolate-serrulate; stem 1–3.5 mm. wide, loosely erect, weak and very flat mostly with broad thin wings nerved like the leaves; nodes one or two, when two the lower one sometimes below the middle of the stem; bracteal leaves erect, usually long and narrow and surpassing the peduncles but sometimes much shorter; peduncles one or two, seldom three, diverging, subequal or very unequal, 3–12 cm. long, slender, but flat and wing-margined, mostly under 1 mm. wide, sometimes nearly filiform, the edges smooth to ciliolate-denticulate: spathes green, often abruptly deflected, small and narrow, not seldom scarcely broader than the peduncle; bracts membranous, weakly or obscurely few-nerved, slenderly attenuate and very acute, or sometimes the inner one apiculate from a somewhat scarious apex, the outer one usually more or less prolonged; outer bract 12–25 mm. long, mostly surpassing the inner one 2–10 mm., but sometimes subequal with it, slenderly attenuate, the margins narrowly white-hyaline, united-clasping for 2–5 mm. at base: inner bract usually closely appressed, under 1.5 mm. long: interior scales half the length of the spathes or less, becoming brownish tinged: flowers 3–5, violet-blue, distinctly fine-nerved, very small, perianth 5–8 mm. long, stamineal column 2.5–4 mm. high: capsules dark, subglobose, very small, 1.5–3 mm. high, on hairlike exserted pedicels somewhat spreading above; seeds only 2–3 in each cell, globose, rough, only obscurely if at all umbilicate, very small, about .75 mm. in diameter.

Alabama and Georgia, in moist soil, flowering in May and June.

ALABAMA: Lee Co., Auburn, several collections by F. S. Earle, C. F. Baker, and L. M. Underwood, 1896–99, in Herb. F. S. Earle, Ala. Biol. Survey and Columbia University.

GEORGIA: Floyd Co., Silver Creek, May 8, 1899, Biltmore Herb.; Jefferson Co., Louisville, Hopkins, Herb. Miss. Bot. Gard.

An interesting species in close relationship with *S. graminoides*, but smaller, with generally much narrower stems and leaves, much smaller flowers and capsules, and fewer smaller seeds; the leaves and stem are also thinner and softer and usually quite without serrulate edges, the leaves more tapering-acute, the small spathes relatively narrower and often or usually abruptly deflected, the bracts commonly more narrowly attenuate and unequal, the pedicels less exserted and flexuous.

The few-seeded capsules are suggestive of *S. dichotomum* to which, in other respects, the species seems to be related, but not so closely as to need detailed comparison.

The above description of the species has been considerably modified to accommodate the collection cited from Silver Creek, Georgia, represented by a very full sheet of specimens. These differ from all the others in serrulate edges of stem and leaf, more slender peduncles uniformly much surpassing the bracteal leaves, rather broader and straighter spathes of less attenuate subequal bracts, the outer one less united clasping, the inner one mostly abruptly pointed from a scarious tip. It is quite possible that this plant merits separate recognition.

Sisyrinchium membranaceum

Rather low, 20–25 cm. high, and loosely erect or assurgent in thin tufts not fibrose at base, arising from rather loosely short-branched rootstocks, the roots slender and nearly simple: plant scarcely if at all glaucescent, becoming dull brownish-green on the herbarium sheet. Leaves loosely suberect, half the height of the stem or more, 1.5–3.5 mm. wide, cuspidate-acute, very thin and membranous, becoming somewhat shining when dry, delicately but prominently few-nerved with a secondary series of faint nerves in the interspaces which are very minutely and closely crystalline-puncticulate, edges of the leaves mostly minutely close-serrulate: stem similar to the leaves, broadly thin-winged, the raised line of the proper stem very narrow: node one, rarely two, bearing a short erect bracteal leaf 2–6 cm. long, and two slender peduncles 4–10 cm. long, frequently longer than the stem: peduncles flat, wing-margined and serrulate-roughened, distinctly constricted transversely below the spathes, the outer one slightly diverging, often only half the length of the erect inner one: spathes green or tinged with purple, slightly deflected or straight, the subequal bracts thin and membranous and delicately or obscurely veined, rather sharply keeled and almost cuspidate-acute, mostly 15 mm. or less long (13–18 mm.) either one slightly the longer, the outer one narrowly attenuate, very narrowly hyaline-edged, united-clasping below for 4–6 mm., sometimes for half its length: inner bract rather broader above and more abruptly acute: interior scales often equaling the bracts or nearly so, but sometimes much shorter, brownish-tinged: flowers 3–5, violet-blue, perianth rather firm and shining membranous in the dried specimens, the segments obovate-oblong, delicately firm-nerved, slenderly aristulate, 10–12 mm. long:

stamineal-column 5 mm. long, anthers small: capsules dark, trigonous-subglobose, 3–5 mm. high, on delicate slenderly exserted pedicels, erect to widely spreading above; seeds only 2–3 in each cell, immature but evidently large.

FLORIDA: Jackson Co., Marianna, April 20, 1899, in full flower; rich shaded soil. Biltmore Herb.

The relationship of this species is with *S. graminoides* and *S. tenellum*. From the latter it is distinguished at once by much larger flowers and capsules without regard to other characters. The flowers are also rather larger than in *S. graminoides* with the broader segments apparently of a more firmly membranous textuae as also are the more strongly few-nerved leaves; the bracteal leaf is much shorter and less foliaceous, the peduncles relatively longer and the often deflected spathes much smaller, with less herbaceous bracts, the outer one more united, clasping below; the interior scales, though variable, become much longer than they are ever seen in *S. graminoides* and the few and larger seeds are a further noteworthy point of difference. The whole plant is lower and less erect than *S. graminoides* and with a more loosely branched underground system.

Sisyrinchium flexile

Tall and slender, about 50 cm. high, apparently in thin tufts, not fibrose-coated at base, pale green but only slightly if at all glaucous. Leaves long and slender, the longer ones equaling the stems or nearly so, rather stiffly erect, withering-persistent, 1.5 mm. wide, closely few-striate, somewhat obtusely pointed with a hardened tip, at least in age, very smooth throughout: stems equally smooth and slender with the leaves, somewhat flexuously erect, subterete and very narrowly firm-margined; nodes one or two, distinctly swollen, when two the lower one bearing a somewhat geniculate slender branch, nearly terete, with slightly roughened margins and a narrow bracteal leaf, the upper node bearing a very short bracteal leaf, sometimes with hardened incurved apex, and two delicate, nearly terete, slightly geniculate peduncles, 3–7 cm. long; spathes pale, slightly deflected, 15 mm. or more long, narrow, especially the subterete base, the bracts subequal, closely striate, their narrow tips scarious-obtuse or sometimes short-apiculate, the inner one sometimes the longer; interior scales silvery white, ½–¾ the length of the bracts; flowers unknown: capsules 5–10, dark brown and rather thick-walled, broadly oblong or obovoid-oblong, 4–6 mm. high, on erect, more or less exserted pedicels slightly spreading above; seeds numerous, very small, .05–1 mm. in diameter, black, alveolate, umbilicate.

MISSISSIPPI: Petit Bois Island, May 8, 1898, with mature fruit, S. M. Tracy.

A very slender species especially characterized by flexuously elongated stems and leaves, peculiarly thickened nodes, scarious-obtuse bracts and very small seeds. It appears to be nearest to *S. Atlanticum*, but possesses many points of difference. In addition to those above referred to may be noted its less glaucous character, firmer and more wiry and subterete narrowly margined stem, narrower spathes of stiffer, less membranous, and more closely striate-nerved bracts, larger capsules. In the two scant specimens, which alone have afforded the outlines of the species, the shortened and scarious-obtuse, outer bract appears to represent a perfectly normal condition; should it prove to be constant it will afford a unique distinctive character among our species.

Sisyrinchium Tracyi

Pale green and slightly glaucescent, discoloring somewhat in drying, rather stout and stiff, 35–70 cm. high, bearing some loose stiff fibers about the base but not densely fibrose-coated; leaves about ¾ the height of the plant or longer, firm and erect, 1–3 mm. wide, close-striate, becoming faintly rugulose, tapering-acute, very smooth throughout: stems rigid, straight or out-curved, 1.5–3 mm. wide, subterete and narrowly firm margined, very smooth; inflorescence stiff and, at least in its early stage, appearing somewhat contracted-sub-paniculate, the lower node bearing one to three erect peduncles and one or two stiff, mostly short branches supporting a cluster of 3 or 4 peduncles; branches subterete and merely margined, smooth or obscurely denticulate, erect or ascending, 4–9 cm. long, the peduncles slender but stiff, approximate, those from the upper nodes 3–5 cm. long; lower bracteal leaf elongated and erect, equaling its inflorescence or shorter, sometimes 16 cm. long; upper bracteal leaves short and stiff: spathes green, sometimes slightly deflected from the abruptly constricted top of the peduncle, about 3 mm. wide, the flattened base rather sharply two-edged, the bracts strongly close-striate, subequal, 15–22 mm. long, the outer one herbaceous or abruptly short-acuminate, the margins white-hyaline, united clasping below for about 5 mm., the inner bract mostly apiculate from a thin scarious-obtuse or truncate apex; interior-scales silvery white, broad, ½ to ¾ the length of the bracts: flowers on erect, scarcely exserted pedicels, violet-blue, the perianth 10–12 mm. long, with long-aristulate segments; stamineal column 5–6 mm. high; fruit not seen.

MISSISSIPPI: Biloxi, March 20, 1898, just in flower, S. M. Tracy.

A rather stout and stiffly erect species, perhaps more suggestive of *S. Atlanticum* than any other but showing material differences. Unlike *S. Atlanticum* it is scarcely if at all glaucous, and has a very rigid and subterete merely margined stem and longer stiffer leaves; the bracteal leaves are more foliaceous and the subpaniculate inflorescence stiffer and more contracted, with the bracts of the spathe thicker and more closely striate-nerved.

Named for Prof. S. M. Tracy whose collections of Mississippi *Sisyrinchia* have furnished several new species.

Sisyrinchium nanum

Described from a single specimen, probably untypical. Low and stiff, 12 cm. high, pale green and glaucous, not at all fibrillose at base, the long descending roots nearly simple and slightly thickened: leaves erect, some of them equaling or surpassing the stems, 1–2 mm. wide, prominently close-striate, tapering to a stiffened subterete, acute apex, very smooth, or sometimes, when young, roughened on the sides with minute points and with denticulate edges, firmly membranous below and abruptly expanded-clasping at the extreme base: stems subterete and stiff with firm narrow margins, the edges smooth; node only one, bearing an erect leaf about equaling the single short outcurved peduncle; peduncles about 3 cm. long, very narrowly margined, smooth-edged or obscurely denticulate, constricted below the spathe; spathes 13 mm. long, narrowed below; bracts closely striate-nerved, the outer one narrowed to a short-pointed apex, the margins broadly white-hyaline to the tip, united-clasping for 5 mm. below; inner bract prominently surpassing the outer one, broadly scarious obtuse and abruptly contracted to the short-apiculate apex, interior scales broad, acuminate, the longer equaling or exceeding the outer bract; flowers apparently few, on slightly exerted pedicels, bright violet-blue, about 10 mm. long; stamineal column 4 mm. high.

MISSISSIPPI: Horn Island, June 1, 1898, Prof. S. M. Tracy.

The specimen cited is a very small plant only just in flower, and it is scarcely probable that it is fairly representative of its species. Ordinarily there would be little excuse for proposing a new species on so slender a basis, but I have the less hesitation in so doing in the present case because it is impossible to reconcile the specimen with any species known to me and the exact locality where it was collected being known the true status and relationship of the plant can be readily ascertained at some future time.

It is to be compared especially with *S. tortum*, agreeing with that species in the short stamineal column; but it differs obviously in other characters, notably in the entire absence of the fibrous investiture of the base of the tufts.

A new Volutella

By Judson F. Clark

(Plate 371)

This fungus was found growing on dead leaves of *Pandanus Veitchii* in the greenhouses of the Botanical Department, Cornell University. Pure cultures were obtained by the ordinary dilution method, and germination and developmental phenomona were studied by growing the fungus in hanging-drop cultures in Van Tieghem cells.

An excellent medium for the development of this form was made by steeping 450 grams of sugar beet, sliced thin, in a liter of water for three hours at 100° C. After straining and cooling, the whites of two eggs were added, and the infusion was again boiled, then strained and filtered. To half the liter was added 6 grams of agar for a solid medium. This infusion of sugar beet and its corresponding agar were used with great satisfaction for the development of various fungi, and were found to be particularly well adapted for the development of many saprophytic forms.

Hanging-drops of the infusion and the agar were inoculated with a few spores from a pure culture. At 6 hrs. (Temp. 28° C.) the spores were germinating freely. The germ tubes were invariably developed from the ends of the conidia (*Plate 371, f. 3*) and in the first stages appeared to be simply a bulging out of the hyaline wall at these points. Two hours later the germ tubes had reached a length of about 20 μ and were beginning to branch by developing a branch close to the end of the original conidium, which could still be distinguished from the germ tubes by its greater diameter. This peculiarity of the first branching (*f. 4*) was quite constant in all cases observed. At 15 hours the cultures presented a mass of well branched, vigorously growing, non-septate mycelium.

At from 24 to 36 hours conidial fructifications of two distinct types made their appearance. The first to appear were the larger submerged sporophores bearing macroconidia. In origin, mode of development, and appearance they resembled the aërial sporophores developed later, but differed from them in size, submerged habit, and character and number of conidia borne. In Fig. 5 is shown a branch of mycelium bearing the macrosporophores, two of which have developed conidia. This drawing was made from a culture in agar where the conidia were held *in situ* by the medium and could be counted. In general each macrosporophore produced 8–12 macroconidia. These latter were rather irregular in shape, varied greatly in size, and were obscurely two-guttate in appearance. The measurements varied from 3.5 $\mu \times 7\ \mu$ to 4.5 $\mu \times 18\ \mu$. Several of these macroconidia are shown in Fig. 2. In germination phenomena they were quite similar to the microconidia.

Some hours after the first appearance of the macrosporophores, smaller, aërial microsporophores were very abundantly developed. These were borne laterally on submerged, and laterally and terminally on aërial hyphae, and abstricted conidia from their apices exactly similar to those examined from the original sporodochia on leaves of *Pandanus*. In figures 6–9 the manner of development of these conidia is shown, and how they remain clustered at the apex of the sporophore, held in position by capillary moisture forming a mucro-like aggregation which sometimes contained a hundred or more microconidia.

On the tenth day sporodochia were observed in the agar cultures. The earliest stage observed was the development of a number of sporophores, in close proximity, bearing a large aggregation of conidia showing in mass a light honey color. Later, the characteristic setae began to make their appearance. Originating in the mass of hyphae near or at the base of the sporodochium, they passed outwards and upwards at varying angles emerging through the spore masses at varying points. The mature sporodochia in these cultures resembled very closely those originally found on *Pandanus*, but differed in having a somewhat more regular appearance and a richer yellow color, variations due no doubt to the altered conditions of development.

On sterile bean pods and sugar beet plugs the growth and conidial fructification was excellent, and quite similar to that already described for the sugar beet infusion and agar. No indication of a perfect (ascus) stage was observed.

The growth on plate cultures was quite characteristic. The center of the colony produced a bunch of fluffy aërial hyphae which was surrounded by a compact ring of rich lemon yellow spore masses, beyond which the mycelium grew out in radiating lines bearing innumerable sporophores and an occasional sporodochium. That this fungus is quite sensitive to changes of temperature was shown by the concentric markings of colonies in Petrie dishes kept in the laboratory where the temperature varied frequently and considerably during the development of the colonies.

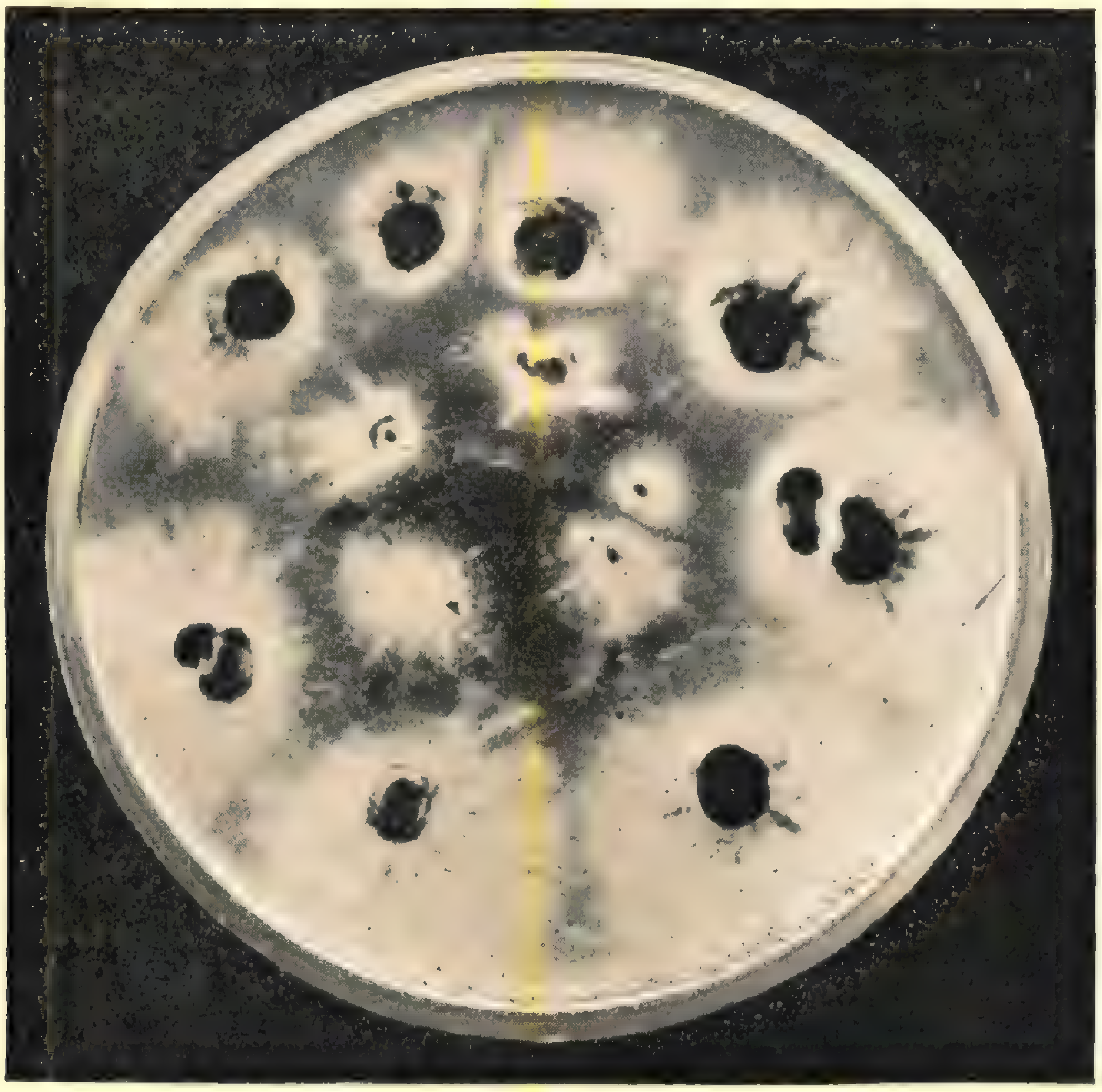


Plate culture of *V. mellea* on sugar beet agar. Grown at first in thermostat at 28° C., but afterwards on shelf in culture room. The fluffy hyphae in the center of the colonies is obscured by underlying spore masses.

Volutella mellea sp. nov.

Sporodochia substipate, irregularly hemispherical, at first white, then honey-colored, becoming brown in age. 100–150 μ in diameter, stratose; setae 10–60, arising irregularly from base of sporodochium and in many cases passing upwards through it, hyaline, continuous, slightly curved, tapering, very slightly roughened, 200–500 μ long x 2–7 μ in diameter; sporophores simple, continuous or rarely 1-septate, always cut off from the hypha by septum, 30–70 μ long, tapering from $2\frac{1}{2}$ μ at base to $1\frac{1}{2}$ μ at apex; conidia hyaline (when viewed singly), oblong, 2–$2\frac{1}{2}$ μ x 4–7 μ, 2-guttate, forming great masses on top of sporodochium.

The species in many particulars resembles closely *V. ciliata* Fr., but differs from it in several important particulars as follow:

VOLUTELLA MELLEA.	VOLUTELLA CILIATA Fr.
Sporodochia at first white, becoming yellow later.	*Sporodochia* albo-carneis.
Stratose.	
Microsporophores 30 to 70 μ x $2\frac{1}{2}$ μ at base to $1\frac{1}{2}$ μ at apex.	Sporophores 10 to 15 μ x 1 μ.
Macrosporophores somewhat larger.	
Hyaline to honey-colored.	Hyaline or dilutely rose.
Microconidia distinctly 2-guttate.	
Macroconidia obscurely 2-guttate.	
On *Pandanus*.	On *Dicotyledons*.

BOTANICAL DEPARTMENT, CORNELL UNIVERSITY.

Explanation of Plate 371

1. Microconidia, × 500.
2. Macroconidia, × 500.
3. Microconidia germinating, × 600.
4. First branching of germ tubes.
5. Branch of mycelium bearing macrosporophores, from culture in sugar beet agar, × 500.

6–9. Microsporophores, showing different stages in the development of a "head" of microconidia, × 500.

10. A young sporodochium (diagrammatic), × 250.
11. A mature sporodochium, many of the spores removed, showing the stratose structure (diagrammatic), × 250.

New and interesting Plants from Western North America.—VIII

By A. A. Heller

Microsteris MacDougalii sp. nov.

Annual, spreading, puberulent or pubescent with short hairs: stem much branched from near the base, 15 cm. high or less, the spread of the branches equalling the height: leaves alternate, usually at the base of a branch, lanceolate, or linear-lanceolate, the lower larger ones 2 cm. long, 2–3 mm. wide: pedicels slender, usually quite short: calyx 5 mm. high, the linear-lanceolate lobes splitting to the base, scarious-edged below, the tips acuminate and cuspidate: corolla pale pink, very small, the tube scarcely or at all exceeding the calyx, the lobes very short: seeds olive-brown.

Dr. D. T. MacDougal's no. 42, collected on "dry hills north of Flagstaff," Arizona, June 3, 1898. The type specimen is deposited in the herbarium of the New York Botanical Garden.

In habit this species is like the northern *M. diffusa*, but very different in other particulars. It is peculiar in having a calyx with lobes split to the base.

Brittonastrum pallidiflorum sp. nov.

Lower portion of stem not seen, the upper portion cinereous puberulent, cymosely branched: branches slender, leafy, 2 dm. or more in length: leaves scattered, opposite, coriaceous, roughened with very short hairs, resinous dotted, the lower ones 4 cm. long, including the petiole, 2.5 cm. wide, broadly ovate, obtuse, cordate at base, crenulate, the petioles 1.5 cm. long, ciliate; leaves of the upper part of the branches smaller, ovate or ovate-lanceolate, acute, somewhat contracted at base, dentate, short-petioled, or the uppermost sessile: spikes 3–5 cm. long, dense, the peduncles and pedicels very short, only about 1 mm. long; bracts equalling or exceeding the calyx, lanceolate or linear-lanceolate, puberulent, ciliate, acuminate; calyx 7 mm. long, about 18-nerved, puberulent resinous dotted, somewhat two-lipped, the lobes lanceolate, acute, whitish, the two lower ones usually slightly shorter than the three upper ones; corolla 14 mm. long, slender, its tube exserted, puberulent or shortly pubescent, upper lip erect, the two lobes short, rounded, the lower lip spreading, with the middle lobe much longer than the lateral ones; stamens and style exserted; style two-lobed.

The type, preserved in the herbarium of the New York Botanical Garden, is Dr. D. T. MacDougal's no. 313, collected in a "cañon near the eastern base of Bill Williams Mountain, Arizona, July 22, 1898."

This species should, perhaps, be described as *Agastache pallidiflora*, as it has considerable resemblance to *Agastache*, especially in the appearance of the spikes. It has, however, the slender, exserted corolla and narrow bracts of *Brittonastrum*, and geographically would seem rather to belong to that genus. It seems to be a connecting link between these closely related genera.

Senecio Hartianus sp. nov.

Perennial, sometimes propagating by underground stolons: stem simple, erect, 3–4 dm. high, lanate, becoming smoother with age: leaves mostly basal, these oval, 12–18 mm. long, some cordate on petioles 1 cm. long, others narrowed into a petiole 3–4 cm. long, finely serrate; stem leaves few, scattered, four to six in number, the lowest lanceolate, petioled, about 3 cm. long, the others linear, sessile, bract-like, all floccose, becoming glabrate with age: heads 4–6 in a terminal corymb; pedicels slender, 1–3 cm. long, somewhat lanate; involucre 5 mm. high, lanate, or becoming glabrate, its bracts linear-lanceolate, acuminate, tipped with purple; rays about 15, oblong, bright yellow, 4 mm. long, 1 mm. wide: achene glabrous: pappus bright white.

No. 230, collected by Dr. D. T. MacDougal, "in valley in open woods near Hart Spring, San Francisco Mountain, near Flagstaff, Arizona, July 5, 1898. The type specimen is deposited in the herbarium of the New York Botanical Garden., A well-marked species of the *S. aureus* group.

SOME LONG-STYLED SPECIES OF DRABA

Certain remarks lately printed by Prof. E. L. Greene in Pittonia concerning the trustworthiness of the statement "authentic specimen from type locality," as printed on some of my labels belonging to the New Mexican collection of 1897, led me to look up the type sheet of *Draba aurea* var. *stylosa*.

I wish to express my thanks to Dr. B. L. Robinson for the privilege of examining this type sheet, as well as the other material in the Gray Herbarium which is associated with it under the varietal name. The investigation of this material, as well as that in the herbaria of the New York Botanical Garden and of Columbia University, which latter contains a sheet of Fendler's no. 43, upon which the variety was founded, proved very interesting. It showed that a number of distinct forms have been included under one name, not only in the original collection, but among later collections as well. Some of these have already been segregated by Professor Greene, but there are others which seem equally worthy of characterization.

DRABA HELLERIANA Greene, Pittonia, **4**: 17. 1899

Draba aurea var. *stylosa* A. Gray, Amer. Journ. Sci. II. **33**: 243. 1862, in part.

Draba stylosa Heller, Plant World, **1**: 23. 1897. Not *D. stylosa* Turcz. 1854.

When the writer raised *Draba aurea* var. *stylosa* of Gray to specific rank in 1897, he failed to note that the name was invalidated by previous use. In the recent diagnosis of *Draba Helleriana* by Professor Greene, our no. 3669, an "authentic specimen from type locality," and Professor Wooton's no. 275, collected in the White mountains, Lincoln county, southeastern New Mexico, were cited as types.

After the description, Professor Greene further remarks that "Mr. Heller's statement, printed on his labels 'Authentic specimen, from type locality,' is mere bombast. Fendler collected no such plant as this; and Mr. Heller did not find the subalpine Fendlerian type on which Gray founded his *D. aurea* var. *stylosa*."

Perhaps my investigations have been very superficial, but so far I have failed to discover Professor Greene's reason for the *positive* assertion that "Fendler collected no such plant as this." Probably Professor Greene has not seen the type sheet of *D. aurea* var. *stylosa*, for on it are two fine examples of this same *D. Helleriana*, and the label says Fendler collected them. Mr. Fendler's field note also shows that he collected this particular form, for the latter part of it reads: "More rarely in the creek bottom and low banks of the creek." In the rich soil on the "low banks of the creek," is exactly where the specimen of mine which Professor Greene has seen, was obtained, and necessarily near the spot of original collection, a fact needing no explanation to one familiar with the topography of Santa Fe cañon. There is also an example of this species in the herbarium of Columbia University, under Fendler's no. 43.

Draba patens sp. nov.

Annual or biennial: stems rather stout, 4 dm. high when mature, branched in the upper three fourths, the branches patent, markedly hirsute with mostly simple hairs, leafy throughout, even on the flowering branches: leaves rather thin, light green, the lowest ones obovate or spatulate, about 2.5 cm. long, 1 cm. wide, petioled, the petioles ciliate; the others ovate-oblong or ovate-lanceolate, acutish or the upper ones acute, sessile at the broad base, roughened on both sides with very short hairs, serrate with prominent spreading teeth, these wanting near the base, especially on the leaves of the lower part of the stem; those on the middle portion of the stem the largest, 3–3.5 cm. long, 1.5 cm. wide: branches bearing flowers and fruit having a spread of 15 cm.: calyx yellowish, the lobes oblong, obtuse, 2 mm. long, somewhat pubescent: petals bright yellow, oblong, twice the length of the calyx: fruiting pedicels slender, pubescent, 5 mm. long; pod twisted, pubescent with short hairs, about 1 cm. long, tipped with a prominent slender style.

The type is Professor E. O. Wooton's no. 275, preserved in the herbarium of the New York Botanical Garden.

This number is cited by Professor Greene as part of his *D. Helleriana*, but the specimen here described is certainly different from my no. 3669, and from Fendler's original in the Gray Herbarium. Professor Wooton's plant differs from mine in its system of branching, not being branched directly from the base, as is mine, but the branches commence some distance above the root, and are widely spread, whereas in my plant the upper branches are strict; the leaf is thinner, broader, of a rather different shape, prominently toothed; the calyx is smoother, and the pods more pubescent.

Since writing the above description, I have seen Professor Wooton's no. 275, as represented in the herbarium of the Missouri Botanical Garden. This specimen differs considerably in general appearance from the one just described, as it has much larger leaves, which are a little thinner, entire, or almost so. It is a marked form, perhaps worthy of varietal rank.

DRABA NEO-MEXICANA Greene, Pittonia, **4**: 18. 1899

Draba aurea var. *stylosa* A. Gray, Amer. Journ. Sci. II. **33**: 243. 1862, in part. Not *D. stylosa* Turcz. 1854.

Professor Greene describes this as "a subalpine species, of the mountains back of Santa Fé, New Mexico; this description drawn from Fendler's no. 43 as found in the U. S. Herbarium."

As has been noted above, a large part of Fendler's no. 43 is represented on the type sheet by *D. Helleriana*, but there are also on it two small plants which are evidently *D. Neo-Mexicana*, according to description.

D. Neo-Mexicana is the plant referred to under *D. Helleriana*, where Professor Greene says that "Mr. Heller did not find the subalpine Fendlerian type on which Gray founded his *D. aurea* var. *stylosa*." Professor Greene was not present with me in New Mexico when I made the collection referred to, neither have I ever told him that I did not collect this particular plant; hence he must have merely inferred that I did not, simply because he never saw it under one of my labels.

Neither am I able to see how he could safely accuse a man of "bombast" when he acknowledged in the citation of the type of *D. Neo-Mexicana* that he had seen only one example of Fendler's no. 43—the one in the U. S. National Herbarium—and that not the type of Gray's *D. aurea* var. *stylosa*.

Furthermore, I fail to find any support for the assertion that this is a subalpine plant, any more than is *D. Helleriana*. In the "Plantae Fendlerianae," the locality is given as "shady declivities, along Santa Fé Creek, at the foot of mountains, etc.; May to July." Fendler's field note reads: "8th May–28th July, 1847. Santa Fé Creek, shady steep declivities and foot of mountains. More rarely in the creek bottom and low banks of the creek." Indeed, if a low, stunted growth alone is to be taken as subalpine, such subalpine plants can be produced at sea level within the tropics.

Fendler not only collected *D. Helleriana* and *D. Neo-Mexicana*, two very distinct forms, but also a third less differentiated one, all included under his no. 43. This third form is present on the type sheet of *D. aurea* var *stylosa*, but it is there represented by only one small plant. It is well represented, however, in the George Engelmann Herbarium at the Missouri Botanical Garden. Through the kindness of Dr. Trelease, I have had the privilege of examining the two sheets of Fendler's no. 43, preserved there. Although averse to the characterizing of varieties, the best way of treating this form seems to be to describe it as a variety.

Draba Neo-Mexicana robusta var. nov.

Multicipitally branched after the manner of *D. Neo-Mexicana*, but with stouter, more pubescent, curved stems, branched above: leaves more numerous and larger. The type in Fendler's no. 43, as represented in the George Engelmann Herbarium at the Missouri Botanical Garden.

Draba pallida sp. nov.

Biennial, or perhaps perennial, somewhat multicipitally branched, cinereous throughout: stems 4 dm. high, beginning to branch near the base, the branches ascending, densely pubescent below with mostly forked hairs, these gradually becoming fewer on the upper parts of the stem, and entirely wanting near the summit: leaves thick and firm, all roughened with a dense, short, stellate pubescence, the basal ones spatulate, clustered in rosettes, entire, about 15 mm. long, 4 mm. wide, tapering into a petiole; those of the stem oblanceolate, 2–3 cm. long, 5–7 mm. wide, sessile, acute, serrate in the upper half with sharp spreading teeth, or the upper reduced ones nearly entire: flowers apparently creamy or white: pedicels slender, strongly divaricate, slightly pubescent, about 5 mm. long: pod equalling or exceeding the pedicel, twisted, glabrous, tipped with a slender style 2 mm. long.

Dr. H. H. Rusby's no. 18, as represented in the herbarium of Columbia University. It was collected on "shady hillsides, Mogollon Mountains, New Mexico, August, 1881."

Draba rubricaulis sp. nov.

Apparently annual: stem 4 dm. high, slender, purplish, branched from near the base, the branches erect, hirsute below with spreading hairs, glabrous above: leaves few, mostly below the branches, thin, light green, sessile, oblong, obtuse, or the smaller upper ones lanceolate, acute, dotted with very short appressed hairs, the veins shortly hirsute, the margin ciliate, the larger ones 3–4 cm. long, 1 cm. wide: branches peduncle-like, subtended by a leaf, naked, or provided with a few short lanceolate bracts about 5 mm. long, the peduncle part 5–10 cm. long, this longer than the flowering portion on the lower branches, one third shorter on the upper ones: pedicels divaricate, slender, glabrous, 1.5 cm. long when mature: sepals oblong or ovate, yellowish, glabrous, 2 mm. long: petals yellow, oblong or oblong-spatulate, obtuse, about 5 mm. long: pods spirally twisted, usually with three spirals, normally shorter than the pedicel, moderately pubescent with short hairs, these more noticeable on the margins, tipped with a slender style 2 mm. long.

C. G. Pringle's no. 1529, collected October 1, 1887, on cool ledges, Sierra Madre, State of Chihuahua, Mexico. The type is in the Gray Herbarium. Its nearest relative is, perhaps, *D. patens.*

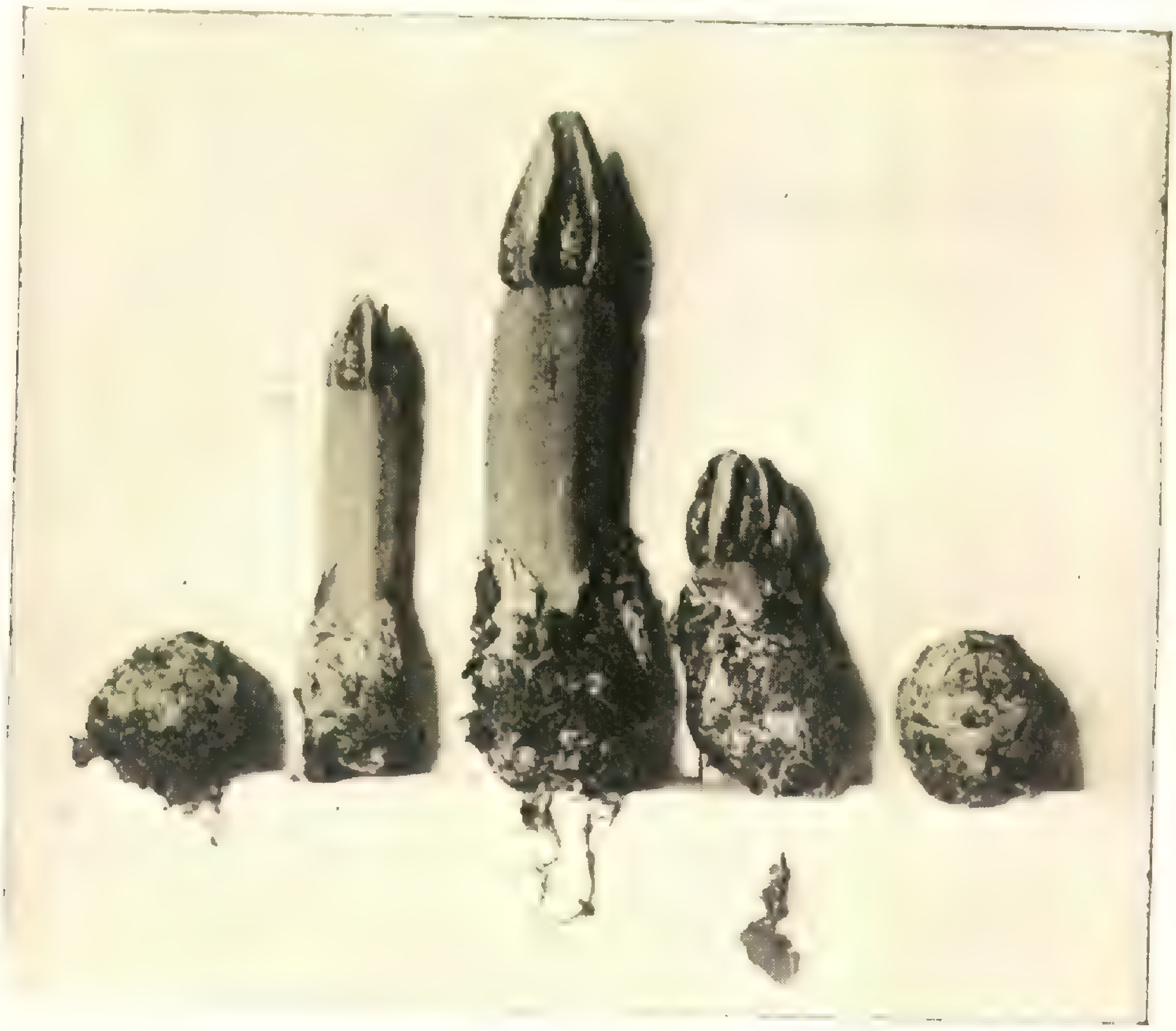
BEDFORD PARK, NEW YORK CITY.

Anthurus borealis Burt.

By David Griffiths

This rare and interesting fungus so beautifully illustrated and fully described by Prof. E. A. Burt, Mem. Boston Soc. Nat. Hist. **3**: 487–505, has been found in a third locality in the state of New York. It has also been collected in one locality in Massachusetts. This then makes the fourth station in which the fungus has been collected. The last locality has furnished more material than any of the others, besides giving some additional data which are thought worth recording.

The records of the distribution of the plant which have come to my notice are as follows: East Galway, Saratoga Co., N. Y., Sept., 1896, E. A. Burt; Sherruck, Delaware Co., N. Y., Aug., 1897, F. B. Southwick, Annual Rep. State Bot., N. Y., 1897: 132; Waltham, Mass., Autumn of 1898, on authority of G. E. Morris; New York City, N. Y., Oct., 1899.



The first collection made the past season was on the eighth of October, in a rectangular plot of ground at the rear of the Library of Columbia University. The area is planted with ornamental shrubbery, and is completely covered with a thin layer of manure and rubbish used as a mulching for the young shrubbery. The surface of the ground has not been disturbed since early spring. The soil is a yellow clay mixed with considerable sand. There are surrounding the library four of these rectangular areas, one at each of the four angles of the building. The treatment of the soil, the planting and the mulching has been practically the same on the four areas during the season, but the two rear ones alone furnished crops of *Anthurus*. The one at the northeast corner produced but about a half dozen plants, but the one at the northwest corner furnished a great number. The locality where the plants were developed in abundance was, therefore, a shaded one, partially protected on all sides by buildings and trees.

It is certain that some plants matured and decayed before their presence was discovered; but the activity of several collectors in the vicinity would reduce the probability of their appearance to not earlier than the first of October. The last mature plants were collected on the 20th of the same month. On two occasions after this date, however, good sized eggs were secured. The last eggs were obtained on the 26th. These elongated in a moist chamber on the 29th. We can then say that the plant appeared approximately during the entire month of October. Doubtless the sudden decline of the temperature from the 19th to the 22d, the drouth which prevailed from this period onward, and the continual disturbance of the ground in search for the eggs all contributed to prevent further development after the 20th.

An abundance of material in various stages of development has been preserved. No less than two dozen eggs were allowed to develop in a moist chamber. One not over 1 ½ cm. in diameter produced an apparently normal plant of but 6 cm. in length. Several smaller eggs than this were secured, but none of them developed. The smallest egg seen was 3 mm. in diameter. The largest plant secured was one which developed naturally on the campus. It measured a little more than 19 cm. in length. The largest plant in the accompanying cut developed in a moist chamber from one of the largest eggs gathered. It measured 16 cm. in length. Fully 60 plants were seen during the month; making allowance for those which decayed unseen, there probably developed 75–100 plants on this small piece of ground.

Eggs considerably developed possess an enormous amount of vitality as evinced by the readiness with which they developed in a moist chamber after being separated from the mycelium. But this is true to a greater or less degree of many if not all of the phallales. One egg which had lain in a moist chamber for two days was cut in two in a median longitudinal plane one morning at 9 o'clock. The two sections were laid on a white piece of paper with the cut surfaces uppermost and placed in a south window to dry, for the purpose of making herbarium specimens of them. Although they remained in the window all day, and in direct sunlight not less than four hours, they elongated during the following night. The cut surfaces of the stipe were dried so that they could not elongate much, but the convex side of the sections elongated to nearly the normal length, and curved around the cut surface making semicircular figures.

Several methods of preservation were resorted to, but the one adopted by Professor Underwood was, on the whole, the most satisfactory, particularly for exhibition purposes; this consisted in stuffing the stipe with cotton and then fixing in 60% alcohol. A strong solution of formalin, 15–30%, gave fairly good results also, but a considerable amount of contraction occurred with all of the fixatives used.

It is fortunate that the plot of ground on which the fungus grew is so favorably situated. It will in all probability remain in practically the same condition as it is now for some time, thus giving an opportunity of studying the plant in the same locality for two or more successive years. It will be interesting to know whether, under favorable circumstances, the plant will appear again in the same locality next year.

Usually the eggs were found aggregated in groups of two to five. The mycelium was very abundant under the mulching, but the eggs were always more or less imbedded in the ground, and always connected with it by strong mycelial strands. The great variation in size has already been mentioned, but this was not necessarily the result of artificial development in a moist chamber, for several very small plants, about 8 cm. in length, were found developed under natural conditions. These, however, as a rule, grew beyond the mulching in the edge of the grass. The number of branches of the receptacle is quite variable. Professor Burt described the plant with five fully developed branches and one abortive one. While this is apparently the normal condition in our specimens, a large number were found with seven arms and a few with eight. But whether with six, seven or eight, the abortive or smaller branch is nearly always present.

The accompanying cut was made from a photograph by Dr. C. C. Curtis, taken from plants which elongated in a moist chamber. The plant in the center of the figure and the one next to it on the right are fully extended. The outside objects are medium sized eggs. The figures are reduced to a little less than one half natural size.

COLUMBIA UNIVERSITY, Nov. 15, 1899.

Some Fungi from South America

By F. S. Earle

Professor C. F. Baker has placed in my hands for determination a small lot of fungi collected during the fall of 1898 near Santa Marta, United States of Colombia. I am indebted to Mr. A. P. Morgan for the examination of the Xylariaceae and to Dr. P. Dietel for the determination of the Uredinales, and for the accompanying notes on them.

COLEOSPORIUM ELEPHANTOPODIS (Schw.) Thüm.

On *Elephantopus* sp., no. 86.

PUCCINIA CLAVIFORMIS Thüm.

On *Solanum* sp., no. 76.

PUCCINIA APPENDICULATA Wint.

On some plant of the Bignoniaceae (?), no. 93.

"The appendages on the stem are poorly developed and are frequently wanting, yet I think it is easy to see that this determination is correct."

Puccinia bombacis Dietel sp. nov.

Sori hypophylli, sparsi, mediocres, pulvinati, firmi, brunnei; teleutosporae oblongae vel ellipsoideae, utrinque rotundatae, varius basi attenuatae, ad septum paulo vel vix constrictae, 30–40 × 13–18 μ, episporio dilute bruneo levi, apice incrassato indentae pedicillo firmo usque 50 μ longo suffulto.

On *Bombax* sp., no. 80.

"This is a *Leptopuccinia* which has the appearance of *Puccinia malvacearum* Mart., but has much smaller spores."

UROMYCES MANIHOTIS P. Henn.—Uredo

"Hennings has only described the telentospores but on specimens received from him I also find the uredospores which correspond exactly with this no. 84."

Uromyces cissampelidis Dietel sp. nov.

Sori hypophylli, minuti, sparsi, uredosporiferi cinnamomei, teleutosporiferi atrofusci; uredosporae obovatae vel subglobosae,

20–26 × 19–23 μ echinulatae brunneae. Teleutosporae ellipsoideae vel rarius globosae, episporio crasso, levi, apice valde incrassato, obscure castaneo indute, pedicello usque 40 μ longo donatae.

On *Cissampelos* sp., no. 83.

SOROSPORIUM SYNTHERISMAE (Schw.) Farl.

On *Andropogon* sp., no. 97.

HYMENOCHAETE PURPUREA Cke. & Morg.

On dead twigs, no. 104.

Auricularia nigra (Schw.) Earle

On dead stumps and logs, nos. 106, 107.

In young specimens the color of the hymenium is ater rather than nigrescent, otherwise the specimens agree well with the description given in Saccardo, Syll. Fung. **6**: 768 (under *Hirneola*). This striking fungus has so much the aspect of a *Peziza* that it is no wonder Schweinitz placed it in that genus.

TRYBLIDIELLA RUFULA (Spreng.) Sacc.?

On dead twigs, no. 103.

Much like this widely distributed and variable species but the ascospores are rather narrow, 24–28 × 7–8 μ, and the disc is black, not at all reddish as is usually the case.

ASTERINA MELASTOMATIS Lev.?

Epiphyllous: perithecia in a scanty radiating brown mycelium, soon confluent, forming black, brittle, somewhat elevated stroma-like crusts, 2–3 or more mm. in diameter, each containing numerous prominent perithecia about 200–300 μ in diameter: asci suborbicular, about 35 × 25 μ, paraphyses none: ascospores inordinate, brown, about equally uniseptate, ends obtuse, 16–20 × 6 μ.

On living leaves of some plant of the Melastomaceae, no. 90.

The description of this species (Saccardo, Syll. Fung. **1**: 51) is too brief and unsatisfactory for positive determination in the absence of authentic specimens. The fact that *Dothidea melastomatis* Kuntze, is given as a probable synonym goes to confirm the correctness of the determination since the mass of confluent perithecia looks much like a black stroma.

PHYLLACHORA GRAMINIS (Pers.) Fckl.

On *Oplismenus*? no. 95.

Apiospora sparsa sp. nov.

Perithecia few, usually one to three or, by confluence, twelve or more, arranged linearly on a scanty inconspicuous subiculum, buried but elevating and rupturing the epidermis, black, small, 150–200 μ, ostiolum papillate-emergent: asci oval, thin-walled, soon ruptured, about 80 × 12–18 μ, paraphyses thread-like, indistinct, soon gelatinized: ascospores obliquely uniseriate or inordinate, narrowly ovate, ends obtuse, straight or slightly curved, hyaline or faintly olivaceous, very unequally two-celled, basal cell about 4 × 4 μ, spore 20–22 × 6 μ.

On the dead culms of some slender grass, no. 105.

HYPOXYLON COCCINEUM Bull.

On dead branches, no. 101 (Det. Morgan).

Hypoxylon Bakeri sp. nov.

Stroma determinate, irregularly rounded, convex, scattered or crowded, about 3–8 mm.: perithecia crowded, covering the entire stroma, globose, prominent, dark brown, black within, large, ¾ mm.; ostiolum minutely papillate, black, shining: asci cylindrical, 60–80 × 5 μ, paraphyses abundant, thread-like: ascospores obliquely monostichous, unequilateral, ends rounded, light brown, 9 × 3–4 μ.

On dead branches, no. 87.

Marsonia agaves sp. nov.

Acervuli scattered or crowded on yellowish areas, large, ½ mm., prominent, orange yellow, at maturity bursting centrally, the lacerate upturned edges of the epidermis surrounding the opening like an aecidia cup: sporules sub-cylindric, ends rounded, at first continuous, finally faintly uniseptate, about 14 × 4 μ.

On languishing leaves of *Agave* sp., no. 97. Other areas on the same leaf are blackened by some miniature fungus, probably belonging to the Pyrenomycetes.

The Mycorhiza of Tipularia unifolia*

BY JULIA B. CLIFFORD

(PLATE 372)

The writer of this paper undertook a study of the anatomical and physiological relations of *Tipularia* and its symbiotic fungus, for the purpose of extending information on mycorhizal adaptations, and thus affording a wider basis for the determination of the actual relation between plants associated in this manner.

The material examined consisted of a number of living specimens from South Corolina, which were grown in the greenhouse of the University of Minnesota. The plant consists of an irregular solid corm which sends out an offset in midsummer, from which is formed a daughter corm, giving rise to a single ovate leaf in the autumn which survives the winter. In the spring the leaf dies away and the corm sends up a scape 49 to 50 centimeters high, bearing a raceme of greenish flowers. The roots are few in number, fibrous, and depend from the base of the corm.

STRUCTURE OF THE ROOTS

The Stele.—The stele is tetrarch, well developed, and fairly large for the size of the root, each bundle consists chiefly of two or three large scalariform ducts and a number of spiral vessels. Alternating with the bundles are groups of twelve to twenty sclerenchymatous fibers in which the lumen is almost obliterated. The pericycle is interrupted, and its elements are quite irregular in mature organs. The endodermal cells are large, uneven in size, the lateral walls are sometimes thickened, and all are suberized.

The Cortex.—External to the stele is a region of the cortex consisting of four to six layers of short cylindrical cells, with small intercellular spaces, and thin cellulose walls. These cells contain large fungal vesicles in contact with the nuclei and those of neighboring elements may be seen to be connected by hyphal threads. In many instances the vesicles almost fill the cells They stain a yellowish brown with Bismark brown and alcohol In the older portions of the root these vesicles are seen to disintegrate and free their contents in the cortex, as has been described by MacDougal in *Corallorhiza*†

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* The work described in this paper was done in the physiological laboratory of the University of Minnesota, under the direction of Professor D. T. MacDougal of the New York Botanical Gardens, who also revised the manuscript.

The nuclei of the cells inhabited by the fungus show a varied behavior. In some instances they are double the normal size, very granular, and hyperchromatic. The shape in such instances varies from spherical to oblong ovoid. In roots examined early in May the nuclei of the infected cells were irregular in outline, diminished in size, and in some instances had fragmented into two or three segments.

External to the region just described is a second, consisting of two layers of long cylindrical cells, with no intercellular spaces, and thickened at the angles. These cells contain active hyphae which form more or less dense convolutions at random, but which do not appear to influence the nucleus of the cell inhabited, as they are fairly normal in size and structure.

The Sheath.—The outer layer of the cortex consists of two kinds of cells ; a long cylindrical form, and a short cylindrical form of smaller diameter. The longer cells are placed with their greater axes parallel to that of the root, and they alternate with the shorter ones which have their longest diameter radial. Any row of cells in this layer consists of the two kinds of cells placed alternately, so that each long cell is separated from the end of the one above it by a short one. The diameter of the short ones is less than that of the long ones, and as a consequence, the edges of the long ones may be prolonged to meet at the sides of the short ones, a fact that may be seen in tangential sections only.

The outer and inner walls of the smaller cells of this layer are noticeably thinner than the later ones and this device allows the ready passage of the hyphae, which crowd through these passage cells so densely as to almost fill the cavities. (Pl. 372. *f. 4.*)

Epidermal Tissue.—External to the sheath is a tissue consisting of four or five layers of thin-walled cells, rich in protoplasm, with no intercellular spaces. This layer is continuous over the apex of the root, on which no cap can be distinguished. It is suggested that this may be a true many-layered epidermis, developed for the especial needs of a mycorhizal organ, similar to that described by Groom in *Thismia* (Annals of Botany, 1895). The outer wall of the external layer is extended in the form of root-hairs which are persistent, and which exhibit great diversity of shapes. Some of these organs are branched, while the apices of others are converted into hollow disks, or into the form of the pileus of a mushroom. These hairs are traversed by hyphae which pass through their lateral walls into the humous soil.

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† Symbiosis and Saprophytism, Bull. Torr. Bot. Club, Oct., 1899.

The cells of the epidermal tissue contain hyphae which pass towards the apex of the root in nearly straight lines. The hyphae give off short lateral branches which are enlarged, and are of the form of the sporophores of some of the moulds, though never seen to develop spores. These organs are cut off from the main hyphae by septae, and are sometimes to be seen separated from the hyphae, and may possibly serve as reproductive bodies. The hyphae are septate throughout all of the regions mentioned.

The hyphae which traverse the root-hairs sometimes form convolutions within them, and nearly all of the hairs thus inhabited show distortions as previously described.

In addition to the symbiotic fungus, the smaller hyphae of a second organism, probably parasitic may be seen in the roots of some specimens.

SUMMARY

The principal features of interest in the mycorhiza of *Tipularia* consist in the lack of the root cap, the development of a many-layered epidermal tissue, which serves the immediate purpose of affording a habitat for the vegetative mycelium of the symbiotic fungus: the formation of a special sheath from the external layer of the cortex, certain cells of which are converted into passage-cells, through which the internal hyphae find an easy passage into the medio-cortex with its rich content of carbohydrates.

The general organization of the fungus, and its relation to the seed plant is similar to that described by MacDougal in *Corallorhiza* and other mycorhizal forms.* The hyphae in the epidermal tissue constitute the vegetative mycelium, which sometimes forms branches which may be reproductive in their primary purpose. Branches are given off which traverse the root-hairs and penetrate the soil, constituting the absorbing organ of the mycorhiza, and which serve to bring the humous products within the root. Branches are given off which penetrate the cortex through the passage cells, forming vesicles which serve as organs of interchange. Starches and other carbohydrates are taken from the higher plant, and proteids are formed from these and the humous products brought in from the soil, which are finally liberated by the disintegration of the vesicles. The seed plant affords a habitat also to the fungus, so that a fairly well balanced symbiosis is the result.

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* Symbiosis and Saprophytism, Bull. Torr. Bot. Club, Oct., 1899.

Explanation of Plate 372

All drawings were made from a Bausch and Lomb one-fifth inch apochromatic objective, and a No. 4 compensating ocular. Magnification 159 except in figure.

FIG. 1. Cross section of stele. *x*, *x*, *x*, *x*, *x*, scalariform ducts. *s*, spiral vessels.

FIGS. 2 and 3. Root-hairs, showing form and traversing hyphae.

FIG. 4. Tangential view of outer cortical sheath, showing the long cylindrical sheath cells, alternating with the short passage-cells.

FIG. 5. Longitudinal section of cortex and epidermis. *c*, outer epidermal cells with root-hairs. *s*, sheath. *o*, region containing vegetative mycelium of fungus. *m*, medio-cortex. *h*, disintegrating vesicles. *n*, nucleus.

Proceedings of the Club

TUESDAY EVENING, OCTOBER 10, 1899

Vice-President Rusby in the chair; 33 persons present.

The following new members were elected: Miss Mary B. Pitman, 304 E. 21st St.; Mrs. Francis B. Arnold, 101 W. 78th St.; Mrs. E. E. Olcott, 38 W. 39th St.; Miss Lucy McIntyre, 303 W. 74th St.; Dr. A. Henri Hart, 73 Lexington Ave.; Mr. S. Whitney Dunscomb, Jr., 132 Nassau St.: nominated by Dr. H. H. Rusby as Chairman of Committee on Membership. Mr. Gustave Heinen, 142 Second Ave.; Miss Rosalie Rosenburg, 128 E. 70th St.: nominated by the Secretary. Miss Annie D'Zan, 63 Stuyvesant Ave., Brooklyn: nominated by the Treasurer.

In response to an invitation from Dr. MacDougal, secretary of section G of the A. A. A. S. a committee was appointed to prepare a memorial program in honor of Dr. Torrey, to be given at the June meeting of the Association in New York; this committee to consist of the President, the Vice-President, the Secretary and two other members whom they shall appoint.

Dr. Britton called attention to the expected opening of the Museum at the Botanical Garden in December, and suggested that it might be appropriate that the first scientific meeting to be held there be that of the Torrey Club, this Club having made the first movement toward starting the Botanical Garden.

The remainder of the evening was devoted to reports from excursions and from summer observations by members.

Dr. Rusby, as guide to nine excursions in the spring, reported an average attendance of 31.

At Floral Park, L. I., May 20th, the club enjoyed the fine botanical library of Mr. C. L. Allen, and the method of cultivating seedling tulips shown by Mr. E. S. Miller.

June 3d the club was very kindly entertained at Fort Lee by Mr. and Mrs. Wm. O. Allison.

Miss Sanial, from the Committee on Field Excursions, followed, making a report embodying lists of species observed during the excursions from June onward.

October 7th the Club went to Plainfield, N. J. The guide, Miss Noll, of Plainfield, invites the Club there in the coming spring, and calls attention to the occurrence of *Mertensia* at the Raritan near that place.

Mrs. Britton reported on a trip June 27, to Closter, N. J., for the purpose of photographing the house in which Austin lived. He is buried at Orangeburg, N. Y., six miles north.

Professor Underwood reported on the Decoration Day excursion to Tullytown, Pa.; about 20 persons from Philadelphia and 12 from New York present. *Isoetes riparia*, a tidal plant, occurred along streams tributary to the Delaware.

Dr. Britton reported further of this trip regarding a patch of pine-barren species explored there, among which grew a *Senecio* resembling *S. Oakesianus* of the Adirondacks but probably different.

Dr. Britton reported also on the 4th of July excursion to the Delaware River at Bull's Island, another *Isoetes, I. Dodgei*, occuring there.

Professor T. C. Porter reported at the latter place the occurrence of *Equisetum littorale, Onosmodium Virginianum*, etc.

Both of these excursions were contributary to Dr. Fretz' revision of Moyer's catalogue of the Bucks Co. flora soon to be issued. It is now being worked out with attention to details of distribution, ecology and modern taxonomic views.

Discussion regarding various gentians followed.

Mr. Van Brunt reported seeing a single stem of *Gentiana crinita* bearing 59 flowers, all the upper, certainly 20, in full bloom. Placing the plants, after clipping, in the dark over night and leaving until 9 or 10 A. M., they expanded beautifully on exposure to the light.

Rev. L. T. Chamberlain reported 96 buds and blossoms on a single stem of *Gentiana crinita* in Mass., at West Brookfield. White blossoms came out in six weeks after it, the stem having bloomed in his study 42 days. Mr. Chamberlain also reported that Dr. Isaac Lea, of Philadelphia, had told him of finding a stem of *Gentiana crinita* with 150 blossoms.

Professor Porter called attention to white flowers of *G. Andrewsii;* it is this he thinks which was described as *G. alba*.

He spoke of the habit of *Gentiana quinqueflora* to produce a great variety of size in the same soil, with little dwarfs with one flower at one inch high.

Professor Porter spoke of *G. flavida* as recently found in Bucks Co.

Dr. Rusby referred to a successful experiment in scattering the seeds of the fringed gentian upon the snow, resulting in a profusion of young seedlings.

Mr. Henshaw paid a tribute to the beauty of the alpine gentians of the Old World, and to the cultivation of seedling tulips by his father, waiting till the seventh year for them to "break," growing only late-flowering tulips. Mr. Henshaw said he had no theory of the cause but had never known one to fail to "break," and knows of no other plant of similar habit.

Rev. L. T. Chamberlain spoke of a walk near Fabyan's in the White Mountains with the whole covering of the earth composed of *Cypripedium acaule*, seemingly a hundred thousand plants.

EDWARD S. BURGESS,
Secretary.

Index to recent Literature relating to American Botany

The Cambridge Botanical Supply Company will discontinue the publication of the Card Index of Literature relating to American Botany, January 1st, and the Committee of Section G of the A. A. A. S. is seeking to continue it under other arrangements. The present subscription price of $5 per year was made when only about 500 cards were issued and is inadequate to support the enterprise with the number of titles increased to upwards of 800.

It has been decided to make the rate one cent per card. The number of subscribers will govern the number of sets printed, and the matter will not be electrotyped. Intending subscribers should notify the editor of the Bulletin of the Torrey Botanical Club at once.

Ames, O. An easy Method of propagating *Drosera filiformis*. Rhodora, **1**: 172. *pl. 8*. S. 1899.

Andrews, L. Soil-preferences of some less usual vascular Plants in central Connecticut. Rhodora, **1**: 103, 104. Je. 1899.

Baker, L. H. Noteworthy Plants at Exeter, Maine. Rhodora, **1**: 75. Ap. 1899.

Bescherelle, E. Note sur le *Philonotula papulans* C. Müll. Rev. Bryol. **25**: 89, 90. 1898.

Bode, G. Ueber Phylloxanthin. Bot. Centralb. **79**: 227–239. 3 Au. 1899.

Brainerd, E. *Hydrastis Canadensis* in Vermont. Rhodora, **1**: 200. N. 1899.

Britton, E. G. A new *Grimmia* from Mt. Washington. Rhodora, **1**: 148, 149. *pl. 7*. Au. 1899.
G. Evansi, sp. nov.

Buchenau, F. Beiträge zur Kenntniss der Gattung *Tropaeolum*. Engler, Bot. Jahrb. **26**: 580–588. 18 Ap. 1899.

Burt, E. A. A List of Vermont Helvelleae, with descriptive Notes. Rhodora, **1**: 59–67. *pl. 4*. Ap. 1899.

Cardot, J. Nouvelle classification des Leucobryacées. Rev. Bryol. **26**: 1–8. 1899.

Clark, H. L. Additions to the Flora of Amherst, Massachusetts. Rhodora, **1**: 164, 165. S. 1899.

Collins, F. S. A seaweed Colony. Rhodora, **1**: 69–71. Ap. 1899.

Collins, F. S. Notes on Algae.—I. Rhodora, **1**: 9–11. Ja. 1899.
Rivularia compacta, sp. nov.

Collins, F. S. To Sea-weed Collectors. Rhodora, **1**: 121–127. Jl. 1899.

Collins, J. F. Notes on the Bryophyte Flora of Maine.—I. Rhodora, **1**: 33–36. F. 1899.

Collins, J. F. Rhode Island Plant-notes.—II. Rhodora, **1**: 105–107. Je. 1899.

Cook, M. P. Some Additions to the "Flora of Middlesex County, Massachusetts." Rhodora, **1**: 80–82. My. 1899.

Coulter, J. M. & Rose, J. N. *Hesperogenia*, a new Genus of Umbelliferae from Mount Rainier. Contr. U. S. Nat. Herb. **5**: 203. *pl. 27*. 31 O. 1899.
H. Stricklandi, sp. nov.

Day, M. A. The local Floras of New England. Rhodora, **1**: 111–120. Je. 1899; 138–142. Jl. 1899; 158. Au. 1899; 174–178. S. 1899; 194–196. O. 1899; 208–211. N. 1899.

Deane, W. Preliminary Lists of New England Plants.—I. Ericaceae. Rhodora, **1**: 93, 94. My. 1899.

Deane, W. Preliminary Lists of New England Plants.—II. Umbelliferae. Rhodora, **1**: 159, 160. Au. 1899.

Dixon, H. N. *Plagiothecium Müllerianum* Schimp. and the allied Species. Rev. Bryol. **26**: 17–21. 1899.

Fernald, M. L. Some Antennarias of Northern New England. Rhodora, **1**: 71–75. Ap. 1899.
A. petaloidea and *A. rupicola*, new species.

Fernald, M. L. Further Notes on New England Antennarias. Rhodora, **1**: 150–155. Au. 1899.
A. ambigens and *A. Brainerdii*, new species.

Fernald, M. L. *Oxytropis campestris* in Northeastern America. Rhodora, **1**: 85–89. My. 1899.

Fernald, M. L. Preliminary Lists of New England Plants.—III. *Antennaria*. Rhodora, **1**: 160. Au. 1899.

Fernald, M. L. Some Plant-names of the Madawaska Acadians. Rhodora, **1**: 166–168. S. 1899.

Fernald, M. L. Some undescribed and little known Varieties of *Aster* and *Solidago.* Rhodora, **1**: 187–191. O. 1899.

Fernald, M. L. Two ambiguous Loosestrifes from the Northern States. Rhodora, **1**: 131–135. *pl. 6.* Jl. 1899.
Lysimachia producta and *L. polyantha*, new species.

Fuller, T. O. Some rare Plants of Needham, Massachusetts. Rhodora, **1**: 179–182. O. 1899.

Ganong, W. F. Polyembryony in *Opuntia vulgaris.* Rhodora, **1**: 127, 128. Jl. 1899.

Graves, C. B. Some noteworthy Plants of southeastern Connecticut. Rhodora, **1**: 67–69. Ap. 1899.

Greene, E. L. A Fascicle of new Violets. Pittonia, **4**: 3–8. 5 Ja. 1899; 9. 31 Ja. 1899.
V. falcata, V. conjugens, V. subsinuata, V. Mistassinica, V. Watsonii, V. retusa, and *V. cyclophylla.*

Greene, E. L. Notes on *Machaeranthera.* Pittonia, **4**: 22–24. 7 F. 1899; 25. 17 Mr. 1899.

Grout, A. J. A Revision of the North American Species of *Scleropodium.* Bull. Torr. Bot. Club, **26**: 531–540. 16 O. 1899.
Scleropodium apocladum (Mitt.) and *S. colpophyllum* (Sulliv.), nom. nov.; *S. colpophyllum attenuatum* var. nov.

Grout, A. J. Suggestions for a more satisfactory Classification of the pleurocarpous Mosses. Rev. Bryol. **26**: 73–77. 1899.

Harper, R. M. Additions to the Flora of Worcester County, Massachusetts.—II. Rhodora, **1**: 201–205. N. 1899.

Holden, I. Two new Species of marine Algae from Bridgeport, Connecticut. Rhodora, **1**: 197, 198. *pl. 9.* N. 1899.
Hydrocoleum majus and *Stictyosiphon subsimplex.*

Hollick, A. See *Newberry, J. S.*

Hosmer, A. W. On the Plants introduced by Minot Pratt at Concord, Massachusetts. Rhodora, **1**: 168–172. S. 1899.

Halsted, B. D. A new Genus of Powdery Mildews—*Erysiphopsis.* Bull. Torr. Bot. Club, **26**: 594, 595. 15 N. 1899.
Erysiphopsis parnassiae, new species.

Heller, A. A. New and interesting Plants from Western North America.—VI. Bull. Torr. Bot. Club, **26**: 547–552. 16 O. 1899.
New species in *Quamasia, Clematis, Aragallus, Mertensia, Hymenopappus,* and *Senecio.*

Heller, A. A. New and interesting Plants from Western North America.—VII. Bull. Torr. Bot. Club, **26**: 588–593. 15 N. 1899.

New species in *Veratrum*, *Verbena*, *Stachys*, *Pentstemon*, *Erigeron*, and *Senecio*; new names in *Petalostemon*.

Henderson, L. F. Two new Species of Plants from the Northwestern United States. Contr. U. S. Nat. Herb. **5**: 201, 202. *pl. 26.* 31 O. 1899.

Aster Latahensis and *Angelica Roseana*.

Hill, E. J. The Habitats of the Pellaeas. Bull. Torr. Bot. Club, **26**: 596–598. 15 N. 1899.

Holway, E. W. D. Some Californian Uredineae. Erythea, **7**: 98. 31 O. 1899.

Puccinia Palmeri (*Aecidium Palmeri* Anderson), *Uredo gaillardiae*, *Aecidium pseudo-balsameum*, and *Aecidium triglochinis*, proposed by Dietel and Holway.

Jepson, W. L. Vegetation of the Summit of Mt. Helena. Erythea, **7**: 105–113. *pl. 3.* 31 O. 1899.

Jones, L. R. The Vermont Botanical Club. Rhodora, **1**: 77, 78. My. 1899.

Kennedy, G. G. A new Moss from Mt. Desert Island. Rhodora, **1**: 78–80. *pl. 5.* My. 1899.

Pottia Randii, sp. nov.

Kindberg, N. C. Mousses récoltées en Alabama (Amérique du Nord), déterminées par N. C. Kindberg. Rev. Bryol. **25**: 92, 93. 1898.

Fabronia Wrightii brachyphylla and *Mnium cuspidatum pachyphyllum* var. nov.

Kindberg, N. C. Note sur un *Hypopterygium* du Canada. Rev. Bryol. **26**: 46–48. 1899.

Hypopterygium Canadense, sp. nov.

Knowlton, C. H. On the Flora of Mt. Abraham Township, Franklin County, Maine. Rhodora, **1**: 191–193. O. 1899.

Kohl, F. G. Untersuchungen über die Raphidenzellen. Bot. Centralb. **79**: 273–281. *pl. 1.* 29 Au. 1899. [Illust.]

Leavitt, R. G. Adventitious Plants of *Drosera*. Rhodora, **1**: 206–208. *pl. 10.* N. 1899.

Lloyd, F. E. Two hitherto confused Species of *Lycopodium*. Bull. Torr. Bot. Club, **26**: 559–567. *pl. 370.* 15 N. 1899.

Lindberg, H. Om *Pohlia pulchella* (Hedw.), *P. carnea* L. och några med dem sammanblandade Former. Acta Soc. Faun. et Fl. Fenn. **16**^{2}: 1–27. *pl.* 1899.

Pohlia decurrens Lindb. fil. sp. nov. from British America and notes on other American species.

MacDougal, D. T. Studies in Plant Physiology. I.–II. Asa Gray Bull. **6**: 73–76. O. 1898; 98–102. D. 1898.

MacDougal, D. T. Symbiosis and Saprophytism. Bull. Torr. Bot. Club, **26**: 511–530. *pl. 367–369.* 16 O. 1899.

MacMillan, C. Minnesota Plant Life. 8vo. Saint Paul, Minn. 1–568. *pl. 1–4. f. 1–240.* 30 O. 1899.

Merriam, C. H. Results of a Biological Survey of Mount Shasta, California. N. A. Fauna, **16**: 1–179. *pl. 1–5. f. 1–46.* 28 O. 1899.

Contains notes on the forests of Shasta, pp. 30–47; and notes on the distribution of Shasta Plants, pp. 135–169.

Merrill, E. D. Notes on Maine Plants. Rhodora, **1**: 185, 186. O. 1899.

Mitchell, A. M. The white Blackberry. Rhodora, **1**: 205, 206. N. 1899.

Molisch, H. Ueber Zellkerne besonderer Art. Bot. Zeit. **57**: 177–191. *pl. 6.* 16 O. 1899.

Moore, J. T. The Pollution of Water-supplies by Algae. Rhodora, **1**: 98–102. Je. 1899.

Nash, G. V. The dichotomous *Panicums;* Some new Species. I. Bull. Torr. Bot. Club, **26**: 568–581. 15 N. 1899.

P. Bushii, P. ciliosum, P. Clutei, P. curtifolium, P. decoloratum, P. Earlei, P. epilifolium, P. flavovirens, P. Helleri, P. paucipilum, P. longiligulatum, P. patentifolium, P. perlongum, P. psammophilum, P. pseudopubescens, P. pubifolium, P. pyriforme, P. strictifolium, and *P. trifolium,* new species.

Newberry, J. S. The later extinct Floras of North America. A posthumous work edited by Arthur Hollick. Monog. U. S. Geol. Survey, **35**: i–xvii. 1–295. *pl. 1–68.* 1898.

Owen, M. L. The Connecticut Valley Botanical Society. Rhodora, **1**: 95, 96. Je. 1899.

Parish, S. B. New and little-known Plants of Southern California. Erythea, **7**: 89–96. 31 O. 1899.

Euphorbia arenicola, Sidalcea nitrophila, Nemophila sepulta, Gilia Hallii, G. tenuiloba, Oreocarya leucophaea confertiflora, Monardella linoides stricta, and *Collinsia callosa,* new species, varieties and names.

Piper, C. V. New and noteworthy northwestern Plants. Erythea, **7**: 99–104. 31 O. 1899.

New species and varieties in *Sitanion, Elymus, Poa, Danthonia,* and *Trillium.*

Porter, T. C. Flora of the Pocono Plateau. Rhodora, **1**: 182–185. O. 1899.

Rand, E. L. *Pinus Banksiana* on Mt. Desert Island. Rhodora, **1**: 135, 136. Jl. 1899.

Rand, E. L. *Subularia aquatica* on Mt. Desert Island. Rhodora, **1**: 155, 156. Au. 1899.

Rydberg, P. A. *Delphinium Carolinianum* and related Species. Bull. Torr. Bot. Club, **26**: 582–587. 15 N. 1899.

D. geraniifolium, *D. albescens*, *D. macroseratilis*, and *D. Wootoni*, new species.

Rydberg, P. A. New Species from the Western United States. Bull. Torr. Bot. Club, **26**: 541–546. 16 O. 1899.

New species in *Juncus*, *Allium*, *Astragalus*, *Potentilla*, *Horkelia*, *Mertensia*, *Symphoricarpos*, *Erigeron*, and *Antennaria*.

Robinson, B. L. Preliminary Lists of New England Plants, IV. Rhodora, **1**: 212–214. N. 1899.

Includes Cistaceae, Elatinaceae, Hypericaceae, Anacardiaceae, Sapindaceae, and Polygalaceae.

Rose, J. N. Notes on useful Plants of Mexico. Contr. U. S. Nat. Herb. **5**: 209–259. *pl. 28–64. f. 31, 32.* 31 O. 1899.

Rose, J. N. Studies of Mexican and Central American Plants.—No. 2. Contr. U. S. Nat. Herb. **5**: 145–200. *pl. 18–25. f. 730.* 31 O. 1899.

Rearrangement of Agaveae. Synopsis of *Nissolia*. Notes on Rutaceae, Turneraceae, *Clitoria*, Malvaceae, Bombaceae, *Passiflora*, *Waltheria*, *Thalictrum*, *Cedrela* and Leguminosae, with numerous new species.

Rose, J. N. Three new Species of *Tradescantia* from the United States. Contr. U. S. Nat. Herb. **5**: 204–206. 31 O. 1899.

T. humilis, *T. gigantea*, and *T. scopulorum*.

Rose, J. N. *Treleasea*, a new Genus of Commelinaceae. Contr. U. S. Nat. Herb. **5**: 207, 208. 31 O. 1899.

Based on *Tradescantia brevifolia*, *T. leiandra*, and *T. tumida*.

Russell, W. S. C. Some Orchids of the upper Pemigewasset Valley. Rhodora, **1**: 199, 200. N. 1899.

Salmon, E. S. *Bryum argentum* L. var. *lanatum* (P. Beauv.) B. & S. Rev. Bryol. **26**: 41, 42. 1899.

Senn, G. Ueber einige coloniebildende einzellige Algen. Bot. Zeit. **57**[1]: 39–104. *pl. 1, 2. figs. 1–39.* 1 Je. 1899.

Shear, C. L. Our Puff balls.—I. Asa Gray Bull. **6**: 93–97. *pl. 2.* D. 1898.

Smith, E. C. Further Additions to the Flora of Middlesex County, Mass. Rhodora, **1**: 97, 98. Je. 1899.

Smith, C. O. Notes on the Species of *Agaricus* (*Psalliota*) of the Champlain Valley. Rhodora, **1**: 161–164. S. 1899.

Stone, G. E. Past and present floral Conditions in Central Massachusetts. Rhodora, **1**: 143–148. Au. 1899.

U[nderwood, L. M.]. Mrs. Arvilla J. Ellis. Bull. Torr. Bot. Club, **26**: 553. 16 O. 1899.

Webster, H. A peculiar State of *Polyporus pergamenus*. Rhodora, **1**: 136, 137. Jl. 1899.

Webster, H. Fungi in Greenhouses. Rhodora, **1**: 83, 84. My. 1899.

Webster, H. *Morchella bispora*. Rhodora, **1**: 156, 157. Au. 1899.

Webster, H. *Hydnum caput-medusae*. Rhodora, **1**: 108–110. Je. 1899.

Wheeler, C. F. Additions to the Michigan Flora since 1892. Rep. Mich. State Board Agric. for 1898:—(1–12). 1899.

Includes list of 233 species of spermaphytes and pteridophytes.

Whitney, L. C. List of Vermont Myxomycetes with Notes. Rhodora, **1**: 128–130. Jl. 1899.

Wiegand, K. M. Some species of *Bidens* found in the United States. Bull. Torr. Bot. Club, **26**: 399–422. 17 Au. 1899.

Discussion and description of the principal members of *Bidens* § *Platycarpae*. *Bidens melanocarpa*, *B. melanocarpa pallida*, *B. frondosa puberula*, *B. comosa acuta*, *B. dentata* (Nutt.), *B. cernua elliptica*, and *B. cernua integra*, new species, varieties and names.

Wille, N. New Forms of green Algae. Rhodora, **1**: 149, 150. Au. 1899.

Elakatothrix Americana sp. nov.

Williams, E. M. Common edible and poisonous Amanitas. Asa Gray Bull. **6**: 80–84. *f. 13*. O. 1898.

Williams, T. A. Half hours with Lichens. Asa Gray Bull. **6**: 1–5. F. 1898; 77–80. O. 1898.

Williams, T. A. *Amanita strobiliformis* Vitt. Asa Gray Bull. **7**: 87, 88. *pl. 6*. O. 1899.

Williams, R. S. Botanical Notes on the Way to Dawson, Alaska. Plant World, **2**: 177–181. Au. 1899.

Williams, E. M. Notes on Amanitas. Asa Gray Bull. **7**: 77–79. Au. 1899.

Williams, E. M. The American Lepiota. Asa Gray Bull. **7**: 67, 68. *pl. 5.* Au. 1899.

Wisselingh, C. van. Ueber das Kerngerüst. Zweiter Beitrag zur Kenntniss der Karyokinese. Bot. Zeit. **57**: 155–176. *pl. 5.* 16 S. 1899.

Yasuda, A. On the Influence of inorganic Salts upon the Conidia-formation of *Aspergillus niger.* Bot. Mag. Tokyo, **13**: 85–90. 20 Jl. 1899.

[This Index is reprinted each month by the Cambridge Botanical Supply Company in card catalogue form.]

Errata

P. 235, fourteenth line. For *five*, read *fine*.

P. 350. No. VIII. was accidentally omitted in numbering this series of papers.

P. 356, twenty-first line. For *C. squarrosa*, read *G. squarrosa*.

P. 444. In "explanation of Plate 366," Fig. 17. For *spores*, × *315*, read *spores*, × *230*.

P. 545, first line. For *Symphoricarpus*, read *Symphoricarpos*.

P. 583, thirteenth line (in key). For *Wootoni*, read *Wootonii*.

P. 587, thirteenth line. For *Wootoni*, read *Wootonii*.

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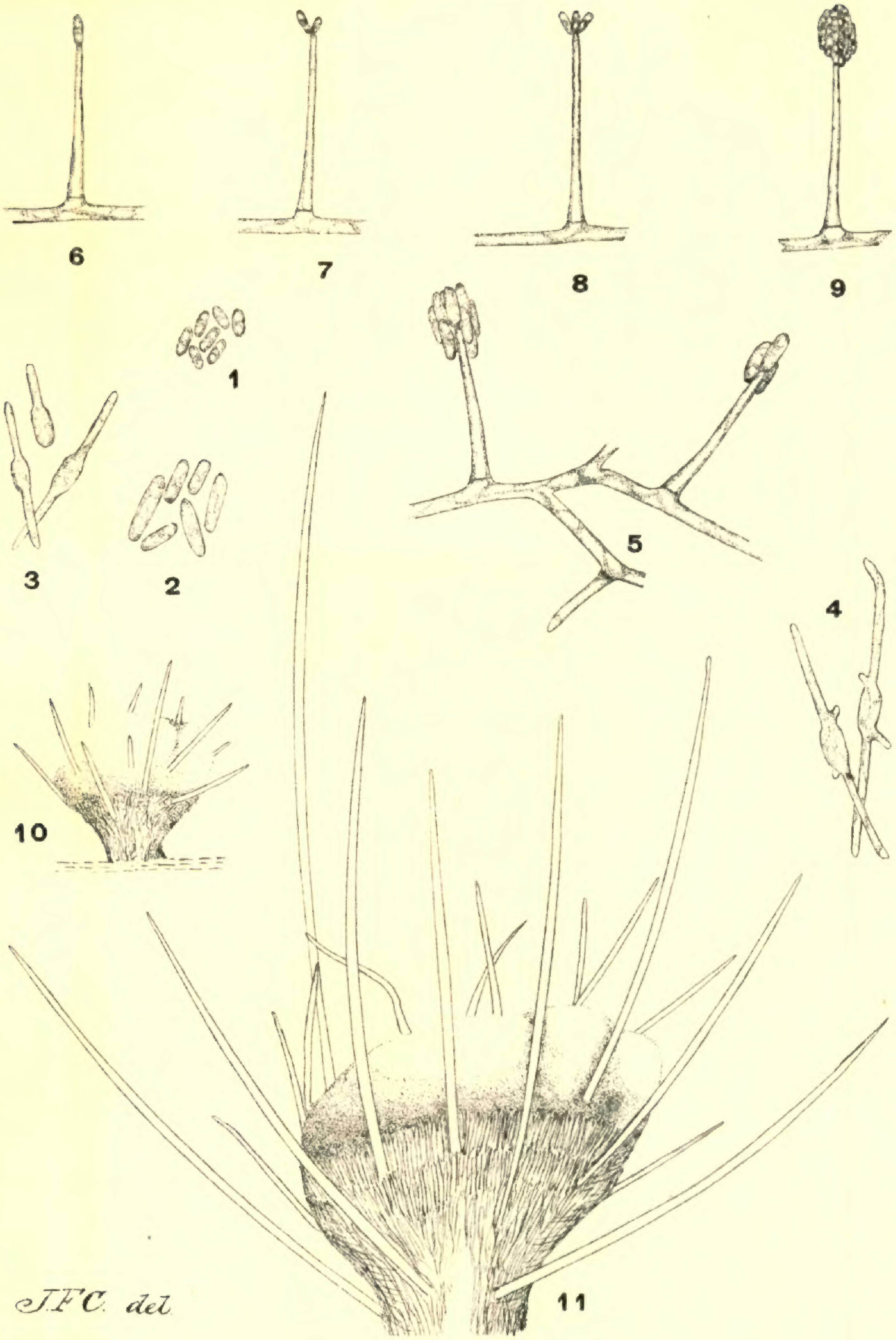
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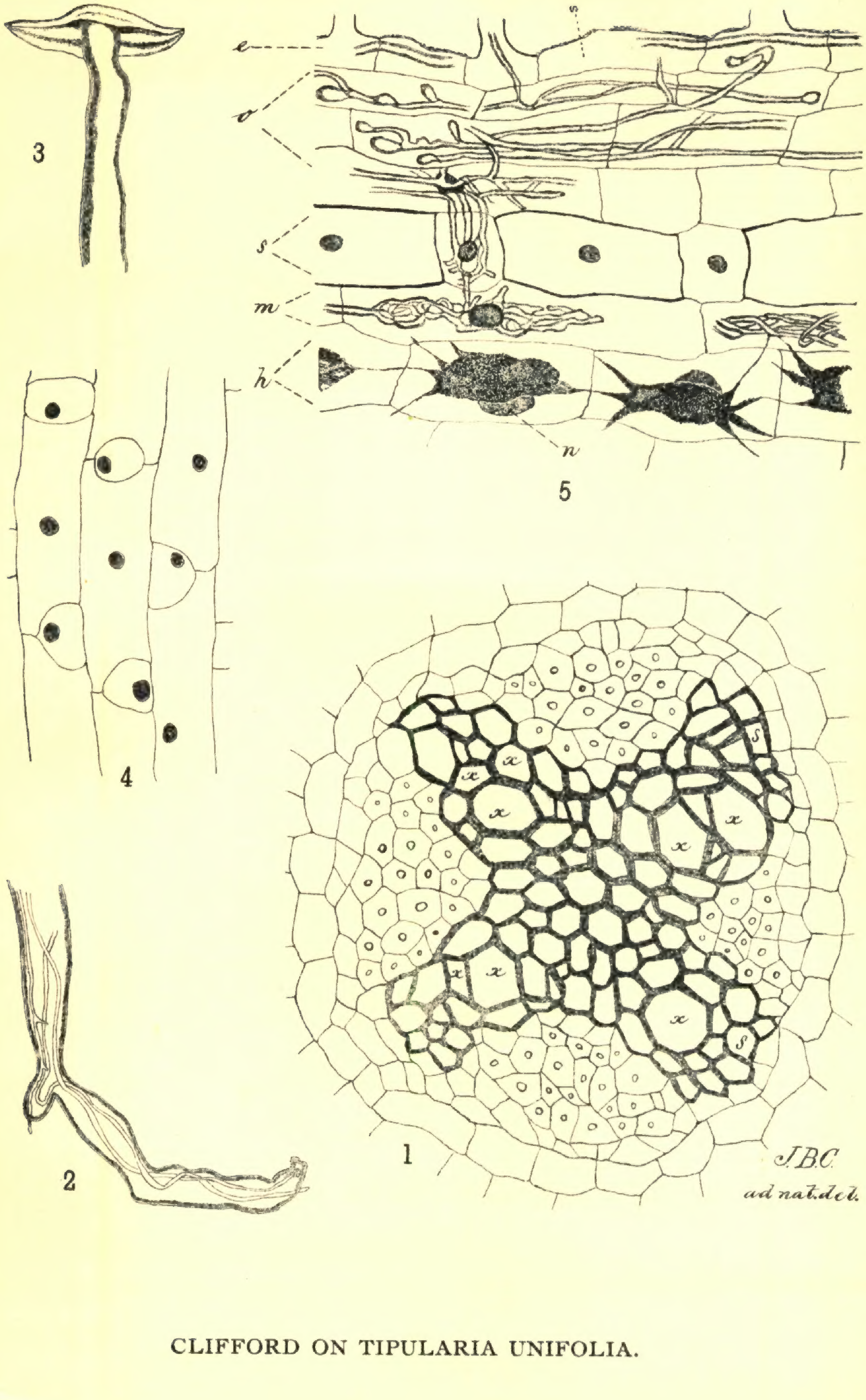
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